Traffic Analysis for the Southern New Castle County TID

Technical Report

Prepared for

DelDOT

DELAWARE DEPARTMENT OF TRANSPORTATION

Prepared by

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Engineering A Brighter Future®

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I. EXECUTIVE SUMMARY

The purpose of this Technical Report is to update the Southern New Castle County TID traffic study that was originally performed in 2004. The original traffic study was used to determine the roadway and intersection improvement needs for the area. The study area is bounded by Lorewood Grove Road and the Chesapeake and Delaware Canal to the north, Marl Pit Road to the south, SR1 and US Route 13 to the east, and US 301/Routes 71 and 896 to the west.

The following intersections are within the study area and were analyzed as part of this study. Intersection configuration diagrams of each study intersection are included in Appendix A.

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13. Marl Pit Road (N429)/Cedar Lane Road (N427)

Based on coordination with New Castle County and DelDOT's Division of Planning, 18 committed developments either proposed or under construction were taken into consideration within the study area. A map depicting the TID study area and the location of each committed development is shown on Page 5 of this document. After the developments were established, the weekday PM peak hour trip generation for each proposed development, which are included in Appendix B, was determined and trip distributions were then created. The weekday PM peak hour was utilized in the analysis as this is typically the time period when traffic volumes are their highest. Traffic volumes at other times of the day are typically lower due to commercial/retail uses not being open during the AM peak hour. In addition, the roadway peaks are higher in a typical weekday than weekends. The trip distributions, which are included in Appendix E, took into account the relevant DelDOT projects within the study area.

DelDOT currently has several projects within the study area. The most prominent projects are the US 301 expressway, the widening of Boyds Corner Road from Cedar Lane to US 13, and the realignment of Jamison Corner Road at Boyds Corner Road. The US 301 project consists of the construction of a four-lane, divided, full access controlled, tolled highway between the Delaware/Maryland state line and SR 1. In addition, the project includes the construction of a

two-lane, divided, full access controlled Spur Road from the US 301 mainline in the Armstrong Corner Road area to the Summit Bridge (SR 896 over the C&D Canal). The Boyds Corner Road project includes the conversion of the existing two-lane roadway to a four-lane divided roadway from Cedar Lane Road to US Route 13. Additional signalization for future commercial and residential entrances will also be included. The Jamison Corner Road project will realign Jamison Corner Road with Cedar Lane Road at Boyds Corner Road to form a four-legged signalized intersection. Separate turn lanes will be provided along each approach to the intersection.

In addition DelDOT has seven other proposed widening projects in the study area including Cedar Lane Road, Road N412A, Lorewood Grove Road (west), Lorewood Grove Road (east), Ratledge Road, Shallcross Lake Road and Jamison Corner Road. All of these roadways will be upgraded to meet DelDOT standards.

Intersection capacity analyses were performed utilizing HCS+ and Sidra Intersection software under 2013 existing and 2030 future conditions. Within Appendix A, Figures A1 and A2 depict the existing and future intersection configurations, respectively. Tables 1 through 13 summarize the LOS results. A more detailed description of the results is included within Section III of this report.

The results indicate that the following intersections would operate at LOS that may require further improvements than those included in DelDOT's proposed transportation improvement projects. Figure A3 in Appendix A depicts the needed lane configurations at these intersections.

- Lorewood Grove Road/Southbound DE Route 1 Off-Ramp
- Lorewood Grove Road/Jamison Corner Road
- Southbound US 301 Ramps/Jamison Corner Road
- Northbound US 301 Ramps/Jamison Corner Road
- US Route 13/Boyds Corner Road/Pole Bridge Road
- Marl Pit Road/Cedar Lane Road

At the Lorewood Grove Road/Southbound DE Route 1 Off-Ramp intersection, a traffic signal along with the provision of two left turn lanes along the northbound SB DE Route 1 Off-Ramp approach would alleviate any LOS deficiency. This improvement would be completed as part of the Lorewood Grove Road (east) project.

At the Lorewood Grove Road/Jamison Corner Road intersection, widening the roundabout to provide two circulating lanes would reduce delays at the intersection; however, the eastbound Lorewood Grove Road approach would still operate at LOS F. Alternatively, the existing roundabout could be converted to a signalized intersection with the provision of dual left turn lanes for the eastbound Lorewood Grove Road and northbound Jamison Corner Road approaches and a separate right turn lane along the southbound Lorewood Grove Road approach when the

monitoring indicates that this intersection is not operating with adequate LOS. These modifications would alleviate any LOS deficiency.

At the Southbound US 301 Ramp/Jamison Corner Road intersection, widening the roundabout to provide two circulating lanes would reduce delays at the intersection; however, the roundabout could be converted to a signalized intersection and separate turn lanes be provided along the northbound and southbound Jamison Corner Road approaches to alleviate any LOS deficiency.

At the Northbound US 301/Jamison Corner Road intersection, widening the roundabout to provide two circulating lanes and the addition of a separate northbound Jamison Corner Road right turn lane would reduce delays at the intersection; however, the roundabout could also be converted to a signalized intersection and separate turn lanes be provided along the northbound and southbound Jamison Corner Road approaches to alleviate any LOS deficiency.

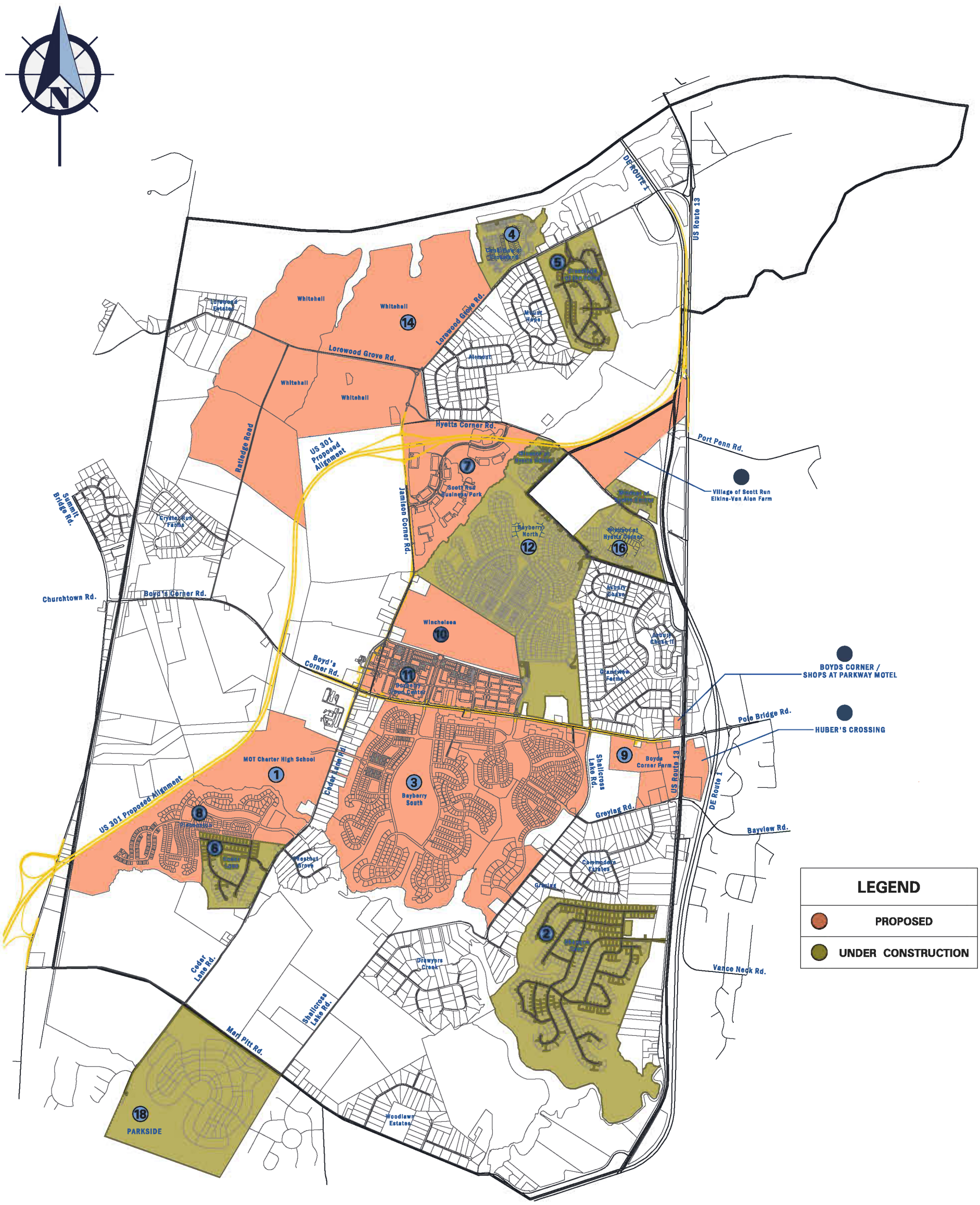
At the US Route 13/Boyds Corner Road/Pole Bridge Road intersection, the westbound Pole Bridge Road approach should be modified to provide one left turn lane, two through lanes, and one right turn lane to operate eastbound Boyds Corner Road and westbound Pole Bridge Road left turn movements as a concurrent phase. In addition, the southbound US Route 13 approach should include one additional through lane, and the northbound US Route 13 approach should provide three left turn lanes to improve the LOS at the intersection. Additionally, the signal should be modified to operate with a 140 second cycle length. With all of these improvements this intersection would operate with LOS E with a delay of 63.6 seconds. Although these improvements would result in LOS E, this finding is based on a conservative analysis where peak hour traffic volumes were not adjusted for changes in driver routes as congestion increases in the area. Specifically, as congestion increases drivers may take different routes, through traffic along US Route 13 may utilize US Route 301, Delaware Route 1, or Delaware Route 71, and peak periods may extend over longer times. These factors, which could result in lower peak hour volumes at this intersection, were not taken into account in the analysis. Therefore, this intersection should be monitored for the need of additional improvements as development continues in the area.

At the Marl Pit Road/Cedar Lane Road intersection, the modification of the intersection to be a single lane roundabout with separate right turn lanes along the southbound Cedar Lane Road and eastbound Marl Pit Road approaches would alleviate any LOS deficiency. However, if a roundabout is not feasible, the intersection could be modified to be signalized with separate left turn lanes along each approach.

A two-way segment analyses was performed for Cedar Lane Road as part of this study. Per the Highway Capacity Manual (HCM) standards two-way segment analyses are typically conducted for highway sections of at least 2.0 miles. As such, the Cedar Lane Road segment length, which is 2.09 miles, satisfies this HCM recommendation.

Cedar Lane Road would operate with LOS D and a v/c ratio of 0.59 with two lanes under 2030 future conditions. As such, any additional roadway widening would not be needed in this segment. Table 14 within this report summarizes the LOS results. The assumptions utilized in the segment analysis are included in Appendix D.

Furthermore, the distribution of traffic within the study area is affected by the current toll structure on DE Route 1 and the proposed tolls for US 301. Within the study area, the South St. Georges interchange provides toll-free access across the DE Route 1 Roth Bridge. With this condition, a higher volume of trips are projected to use these ramps than would be anticipated under a toll neutral condition. Conversely, the DE Route 1/Boyds Corner Road interchange, where the ramp tolls are $.50, is underutilized. The proposed toll at the US 301/Jamison Corner Road interchange is $.50. The effect of these tolls is to increase traffic on Lorewood Grove Road and on US Route 13 from Boyds Corner Road to the South St. Georges interchange. Modification of the toll structure could be considered as a traffic mitigation measure.



#	NAME	STATUS	#	NAME	STATUS
1	MOT CHARTER SCHOOL	PROPOSED	10	WINCHELSEA	PROPOSED
2	CROMWELL AKA SHANNON COVE	UNDER CONSTRUCTION	11	BAYBERRY TOWN CENTER	PROPOSED
3	BAYBERRY SOUTH	PROPOSED	12	BAYBERRY NORTH	UNDER CONSTRUCTION
4	CANALVIEW AT CROSSLAND	UNDER CONSTRUCTION	13	BOYDS CORNER/SHOPS AT PARKWAY MOTEL	PROPOSED
5	CROSSLAND AT THE CANAL	UNDER CONSTRUCTION	14	WHITEHALL	PROPOSED
6	CEDAR LANE	UNDER CONSTRUCTION	15	VILLAGE OF SCOTT RUN / ELKINS-VAN ALEN FARM	PROPOSED
7	WHITEHALL SCOTT RUN BUSINESS PARK	PROPOSED	16	WINDSOR AT HYETTS CORNER	UNDER CONSTRUCTION
8	PLEASANTON	PROPOSED	17	HUBER'S CROSSING	PROPOSED
9	BOYDS CORNER FARM (COBURN FARM)	PROPOSED	18	PARKSIDE	UNDER CONSTRUCTION

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COMMITTED DEVELOPMENTS PROPOSED & UNDER CONSTRUCTION

II. METHODOLOGY

Existing 2013 Volumes

Traffic counts at the study intersections were performed in 2010, 2011, and 2013. The 2010 and 2011 counts were increased by a growth factor to create the 2013 volumes. Seasonal adjustment factors were also applied to the 2013 volumes. Additionally, the through volumes between the Summit Bridge Road and Ratledge Road intersections along Boyds Corner Road were balanced due to the close proximity and the limited development between those two intersections.

Trip Generation

In order to conduct the future traffic analysis at each study intersection within the TID, coordination with New Castle County and DelDOT's Division of Planning was done to determine which future developments are proposed to be constructed within the district. The Committed and Potential Developments list in Appendix B indicates the 18 developments that were included in the analysis. Additionally, this list details the land uses and corresponding sizes associated with each development. The land use information was obtained from New Castle County with the exception of the Whitehall development which was obtained from the latest development plan and the Parkside development which was obtained from the Town of Middletown. It should be noted that the land use information utilized for the Village of Scott Run/Elkins Van Alen Farm was based on the acreage of the property that would not be impacted by the DelDOT US 301 project.

After the developments were established, the weekday PM peak hour trip generation for each proposed development was determined using the comparable land use and rates/equations contained in the *Trip Generation, 9th Edition: An ITE Informational Report*, published by the Institute of Transportation Engineers (ITE). Appendix B contains a table summarizing the trip generation for each development. The weekday PM peak hour was utilized in the analysis as this is typically the time period when traffic volumes are their highest. Traffic volumes at other times of the day are typically lower due to commercial/retail uses not being open during the AM peak hour.

In accordance with ITE guidelines, internal capture was applied to the developments containing residential, office, and retail uses. Additionally, pass-by rates contained within the ITE *Trip Generation Handbook, 2nd Edition* was applied to the shopping center and restaurant land uses within each development. Although this is a suburban area, the ITE approved pass-by traffic percentages which are more applicable to urbanized conditions were applied to those uses for a more realistic approach.

Further, the developable areas at the Whitehall Scott Run Business Park and Windsor at Hyetts Corner developments are projected to be impacted by the DelDOT US 301 project. As such, to

take into account the effects of the US 301 project on these developments, the trip generation at each of those sites were reduced by 20%.

Trip Assignment

Trip distributions were completed by assigning traffic to the roadway network in accordance with observed as well as projected traffic patterns as a result of the future development. For office, school, and retail uses it was assumed that many of the site traffic trips would be originating from other developments within the TID area than being from outside the network. Additionally, the final layouts of the US 301, Boyds Corner Road, and Jamison Corner Road projects were taken into consideration when developing the trip distribution. These layouts include the US 301 interchange ramps along Jamison Corner Road, the realignment along Boyds Corner Road of Cedar Lane Road with Jamison Corner Road, as well as the realignment along Boyds Corner Road of Shallcross Lake Road with Milford Drive. Furthermore, the location of the US 301 tolls were also considered as some travelers would likely avoid toll routes when available. The development trip distributions were also compared with the previously approved distributions and adjusted as needed. The trip distributions utilized in the analysis, which are included in Appendix E, were reviewed and approved by DelDOT's Division of Planning.

Future 2030 Volumes

The existing 2013 traffic volumes were increased by a growth factor to develop the future 2030 base volumes. The 2030 base volumes at the Boyds Corner Road intersections with Cedar Lane Road, Jamison Corner Road, Shallcross Lake Road, and Milford Drive were adjusted to take into account the realignment projects.

The established trip assignments were added to the future 2030 base volumes to develop the future 2030 volumes. The future 2030 volumes were then compared to the volumes utilized in the US 301 project. As a result, some volumes were modified to be comparable to those used in the US 301 project. After the modification, the final future 2030 volumes were utilized in the analysis. Figures depicting the existing and future volumes utilized in this analysis are included in Appendix C. The 2030 projected AADT volumes are also included in Appendix C.

III. INTERSECTION LOS ANALYSIS

Intersection Analysis Results Descriptions

1. Lorewood Grove Road (N412) / SB DE Route 1 Off-Ramp (N82)

Under existing conditions, one lane is provided along the eastbound and westbound Lorewood Grove Road approaches to this unsignalized intersection. One left turn lane that is stop-controlled and one channelized right turn lane that is yield controlled is provided for the northbound SB DE Route 1 Off-Ramp approach. With the existing and future 2030 volumes, this intersection operates at LOS F.

The installation of a traffic signal at this intersection is an off-site improvement associated with the Crossland development. With the installation of a traffic signal and the existing lane configurations, this intersection would continue to operate at LOS F.

In order to address the LOS deficiency, two left turn lanes could be provided along the northbound SB DE Route 1 Off-Ramp approach to the intersection. With the additional left turn lane this intersection would operate at LOS D under future 2030 conditions.

2. Lorewood Grove Road (N412) /Jamison Corner Road

A one lane roundabout is present at the intersection and is assumed to remain under future 2030 conditions. With the existing volumes each approach to the intersection operates at LOS A. However, with the future 2030 volumes, each approach to the intersection would operate at LOS F.

In order to address the LOS deficiency two improvement options would be available. The first option involves widening the roundabout to provide two circulating lanes. Two northbound Jamison Corner Road lanes containing one left turn lane and one through lane would enter the roundabout. Two through lanes and a separate right turn lane would be provided along the southbound Lorewood Grove Road approach. Two eastbound Lorewood Grove Road lanes containing one left turn lane and one right turn lane would also enter the roundabout. These modifications would significantly reduce delays along each approach, however, the eastbound Lorewood Grove Road approach would operate at LOS F.

The second option involves the modification of the roundabout to be signalized with a 120 second cycle length. With the installation of a traffic signal, the proposed layout would provide two left turn lanes and one right turn lane along the eastbound Lorewood Grove Road approach, two left turn lanes and one through lane along the northbound Jamison Corner Road approach, and one through lane and one right turn lane along the southbound Lorewood Grove Road approach. With these improvements, the intersection would operate at LOS D under future 2030 conditions.

3. Southbound US 301 Ramps/Jamison Corner Road

Under future 2030 conditions, a one lane roundabout would be constructed at this intersection as part of the DelDOT US 301 project. However, the northbound and southbound Jamison Corner Road approaches to the intersection would operate at LOS F with the future volumes.

In order to address this LOS deficiency, two improvement options would be available. The first option involves widening the roundabout to provide two circulating lanes. Two northbound Jamison Corner Road lanes containing one shared through/left turn lane and one through lane would enter the roundabout. Two southbound Jamison Corner Road lanes containing one through lane and one shared through/right turn lane would also enter the roundabout. One entering lane would be provided along the westbound SB US 301 Ramp approach. These modifications would improve each approach to the intersection to operate at LOS C or better.

The second option involves the modification of the roundabout to be signalized with a 120 second cycle length. With the installation of a traffic signal the proposed layout would consist of one left turn lane and one through lane along the northbound Jamison Corner Road approach, one through lane and one right turn lane along the southbound Jamison Corner Road approach, and one shared left turn/right turn lane along the westbound SB US 301 Ramp approach. With these improvements the intersection would operate at LOS D.

4. Northbound US 301 Ramps/Jamison Corner Road

Under future 2030 conditions, a one lane roundabout would be constructed at this intersection as part of the DelDOT US 301 project. However, the northbound and southbound Jamison Corner Road approaches to the intersection would operate at LOS F with the future volumes.

In order to address the deficiencies, two improvement options would be available. The first option involves widening the roundabout to provide two circulating lanes. Two through lanes and a separate right turn lane would be provided along the northbound Jamison Corner Road approach. Two lanes containing one shared through/left turn lane and one through lane would be provided along the southbound Jamison Corner Road approach. One entering lane would be provided along the eastbound NB US 301 Ramp approach. These modifications would improve each approach to the intersection to operate at LOS C or better.

The second option involves the modification of the roundabout to be signalized with a 120 second cycle length. With the installation of a traffic signal the proposed layout would consist of one through lane and one right turn lane along the northbound Jamison Corner Road approach, one left turn lane and one through lane along the southbound Jamison Corner Road approach, and one shared left turn/right turn lane along the eastbound NB US 301 Ramp approach. With these improvements the intersection would operate at LOS D.

5. <u>Summit Bridge Road (N16/N39)/Boyds Corner Road (N15)/Churchtown Road (N432)</u>

Under existing and future 2030 conditions, this signalized intersection would operate with one left turn lane and a shared through/right turn lane along the eastbound Churchtown Road approach, two left turn lanes, one through lane, and one right turn lane along the westbound Boyds Corner Road approach, one left turn lane, two through lanes, and one right turn lane along the northbound Summit Bridge Road approach, and two left turn lanes, two through lanes, and one right turn lane along the southbound Summit Bridge Road approach.

This signalized intersection is expected to operate at LOS D under 2013 existing and 2030 future conditions.

6. <u>Boyds Corner Road (N15)/Ratledge Road (N414)</u>

Under existing conditions this intersection provides one shared left turn/through lane along with a bypass lane along the eastbound Boyds Corner Road approach, one through lane and one right turn lane along the westbound Boyds Corner Road approach, and one shared through/left turn lane along the southbound Ratledge Road approach. With the existing volumes this intersection operates at LOS C or better. However, with the future 2030 volumes, this intersection operates at LOS F.

The modification of the southbound Ratledge Road approach to provide a separate left turn and right turn lane and the modification of the eastbound Boyds Corner Road approach to provide a separate left turn lane are off-site improvements associated with the Pleasanton development. Additionally, the installation of a traffic signal at this intersection is an off-site improvement associated with the Bayberry Town Center development. With the installation of a traffic signal with a 120 cycle length, this intersection would operate at LOS D.

7. <u>Boyds Corner Road (N15)/Jamison Corner Road (N413)/Cedar Lane Road (N427)</u>

Under existing conditions, Boyds Corner Road intersects separately with Jamison Corner Road and Cedar Lane Road to create two intersections. The Boyds Corner Road intersection with Cedar Lane Road is signal controlled. A through lane and a right turn lane are provided along the eastbound Boyds Corner Road approach, a left turn lane and a through lane are provided along the westbound Boyds Corner Road approach, and a shared left turn/right turn lane is provided along the northbound Cedar Lane Road approach. With existing volumes this intersection is operating at LOS A.

At the Boyds Corner Road intersection with Jamison Corner Road, a left turn lane and a through lane are provided along the eastbound Boyds Corner Road approach, a through lane and a right turn lane are provided along the westbound Boyds Corner Road approach, and a shared left turn/right turn lane is provided along the southbound stop-controlled Jamison Corner Road approach. With existing volumes this intersection is operating at LOS C or better.

Under future 2030 conditions, Cedar Lane Road and Jamison Corner Road will be aligned with each other and will be controlled by a traffic signal as part of a DelDOT improvement project. With the installation of a traffic signal the proposed layout would consist of two left turn lanes, two through lanes, and one right turn lane along the eastbound and westbound Boyds Corner Road approaches as well as one left turn lane, one through lane, and one right turn lane along the northbound Cedar Lane Road and southbound Jamison Corner Road approaches. With these improvements, this intersection would operate at LOS D.

8. Boyds Corner Road (N15)/Town Center Drive/West Central Park Drive

Under future 2030 conditions, this signalized intersection would be constructed as part of the Bayberry Town Center and Bayberry South developments. One left turn lane, two through lanes, and one right turn lane would be provided along the eastbound and westbound Boyds Corner Road approaches. One left turn lane, one shared through/left turn lane, and one right turn lane would be provided along the northbound West Central Park Drive and southbound Town Center Drive approaches. This signalized intersection would operate at LOS D under future 2030 conditions.

9. Boyds Corner Road (N15)/North Bayberry Parkway/South Bayberry Parkway

Under future 2030 conditions, this signalized intersection would be constructed as part of the Bayberry Town Center and Bayberry South developments. One left turn lane, two through lanes, and one right turn lane would be provided along the eastbound and westbound Boyds Corner Road approaches. One left turn lane, one shared through/left turn lane, and one right turn lane would be provided along the northbound and southbound Bayberry developments. This signalized intersection would operate at LOS C under future 2030 conditions.

10. Boyds Corner Road (N15)/Milford Drive/Shallcross Lake Road (N428)

Under existing conditions, Boyds Corner Road intersects separately with Milford Drive and Shallcross Lake Road to create two unsignalized intersections. At the Boyds Corner Road intersection with Shallcross Lake Road, a through lane and a right turn lane are provided along the eastbound Boyds Corner Road approach, one shared through/left turn lane and a bypass lane are provided along the westbound Boyds Corner Road approach, and a shared left turn/right turn lane is provided along the northbound stop-controlled Shallcross Lake Road approach. With existing volumes this intersection operates at LOS C or better.

At the Boyds Corner Road intersection with Milford Drive, a left turn lane and a through lane are provided along the eastbound Boyds Corner Road approach, a through lane and a right turn lane are provided along the westbound Boyds Corner Road approach, and a shared left turn/right turn lane is provided along the southbound stop-controlled Milford Drive approach. With existing volumes this intersection operates at LOS C or better.

Under future 2030 conditions, Shallcross Lake Road and Milford Drive will be aligned with each other and will be controlled by a traffic signal as part of a DelDOT improvement project. With the installation of a traffic signal the proposed layout would consist of one left turn lane, two through lanes, and one right turn lane along the eastbound and westbound Boyds Corner Road approaches as well as one left turn lane, one through lane, and one right turn lane along the northbound Shallcross Lake Road and southbound Milford Drive approaches. With these improvements, this intersection would operate at LOS D.

11. <u>Boyds Corner Road (N15)/Entrance to Boyds Corner Farm</u>

Under future 2030 conditions, this signalized intersection is proposed to be constructed as part of the Boyds Corner Farm development. Two through lanes and one right turn lane would be provided along the eastbound Boyds Corner Road approach, one left turn lane and two through lanes would be provided along the westbound Boyds Corner Road approach, and two left turn lanes and one right turn lane would be provided along the northbound Boyds Corner Farm Entrance. This signalized intersection would operate at LOS C under future 2030 conditions.

12. <u>US Route 13 (N22A)/Boyds Corner Road (N15)/Pole Bridge Road (N420)</u>

Under existing conditions and future 2030 conditions, this intersection would be controlled by a traffic signal. Under existing conditions, two left turn lanes, two through lanes, and one right turn lane are provided along the eastbound Boyds Corner Road approach, one left turn lane, one shared through/left turn lane, one through lane, and one right turn lane are provided along the westbound Boyds Corner Road approach, and two left turn lanes, three through lanes, and one right turn lane are provided along the northbound and southbound US Route 13 approaches to the intersection. This intersection operates at LOS D under the existing condition. However, with the projected future 2030 volumes this intersection would operate at LOS F.

To address the LOS deficiencies, three improvement options were evaluated. The first improvement option involves the modification of the westbound Pole Bridge Road approach to provide one left turn lane, two through lanes, and one right turn lane. As a result of the modification, the split phase signal phasing along the eastbound Boyds Corner Road and westbound Pole Bridge Road approaches would be removed and the eastbound and westbound left turn movements would operate concurrent with each other during a protected phase. This improvement option would help to minimize delay, but the intersection would still operate with LOS F.

The second improvement option involves the improvements described in the first option, but with an additional southbound US Route 13 through lane. This additional through lane would improve the LOS at the intersection to LOS E.

The third improvement option involves the improvements described in option two, but with three northbound US Route 13 left turn lanes and a 140 second cycle length. The additional left turn

lanes and the reduced cycle length would reduce the delay further at the intersection, resulting in a better LOS E.

13. <u>Marl Pit Road (N429)/Cedar Lane Road (N427)</u>

Under existing conditions this intersection operates under all-way stop control with one lane provided along each approach. All approaches to this intersection operate at LOS C or better under existing conditions. However, with future 2030 volumes each approach to this intersection would operate at LOS F.

The modification of this intersection to either be a roundabout or to have a traffic signal installed is an off-site improvement associated with the Pleasanton, Scott Run Business Park, Cedar Lane, Bayberry Town Center, Bayberry North, and Bayberry South developments. JMT has reviewed both options as part of this analysis.

The first option involves the modification of the intersection to be a single lane roundabout with separate southbound Cedar Lane Road and eastbound Marl Pit Road right turn lanes. With a roundabout, each approach would operate at LOS E or better.

The second option involves the modification of intersection to be signalized. Additional improvements would include the provision of separate left turn lanes along each approach. With the installation of a signal and the additional turn lanes, this intersection would operate at LOS C. As part of the Southern New Castle County TID, Cedar Lane Road and Marl Pit Road will be improved to DelDOT standards. One of these projects will include the improvement of this intersection.

General HCS Analysis Comments

(See table footnotes on the following pages for specific comments)

1. JMT used HCS+T7F, Version 5.5 for the analysis.

2. For future conditions, JMT used peak hour factors consistent with the guidelines provided in the *DelDOT Standards and Regulations for Subdivision Streets and State Highway Access* (0.80, 0.88, or 0.92 based on the total intersection volumes, or the peak hour factor based on existing turning movement counts, when greater).

3. For future conditions, JMT used heavy vehicle percentages consistent with the guidelines provided in the *DelDOT Standards and Regulations for Subdivision Streets and State Highway Access (*3% heavy vehicles for each movement at intersections when there is a significant change in intersection volume).

4. Right-turn-on-red volumes were utilized at existing signalized intersections. Under future 2030 conditions, the right-turn-on-red volumes were increased proportionally at existing signalized intersections. However, at proposed signalized intersections, JMT did not use right-turn-on-red volumes since data was not available and instead modeled the right turn movements as permissive within the signal phasing where separate right turn lanes would be provided.

Table 1
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Unsignalized Intersection[1] (T-Intersection)	**LOS per JMT**
Lorewood Grove Road/ Southbound DE Route 1 Off-Ramp	Weekday PM
2013 Existing	
Northbound SB DE Route 1 Off-Ramp	F (145.7)
2030 Future	
Northbound SB DE Route 1 Off-Ramp	F (2028.0)

Signalized Intersection[1] (T-Intersection)	**LOS per JMT**
Lorewood Grove Road/ Southbound DE Route 1 Off-Ramp	Weekday PM
2030 Future[2]	F (137.9)
2030 Future *with Improvement Option 1*[3]	D (49.7)

[1]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[2]The installation of a traffic signal at this intersection is an off-site improvement associated with the Crossland development. JMT analyzed the intersection with the existing lane configurations and a 150 second cycle length.
[3]Improvement Option 1 involves the provision of two left turn lanes along the northbound approach.

Table 2
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Roundabout[4]	**LOS per JMT**
Lorewood Grove Road/Jamison Corner Road	Weekday PM
2013 Existing	
Northbound Jamison Corner Road	A (3.7)
Southbound Lorewood Grove Road	A (7.5)
Eastbound Lorewood Grove Road	A (4.7)
2030 Future	
Northbound Jamison Corner Road	F (498.2)
Southbound Lorewood Grove Road	F (640.5)
Eastbound Lorewood Grove Road	F (202.2)
2030 Future *with Improvement Option 1*[5]	
Northbound Jamison Corner Road	C (15.8)
Southbound Lorewood Grove Road	F (65.4)
Eastbound Lorewood Grove Road	F (53.7)

[4]Roundabout analysis was performed using SIDRA Intersection 5.1. The numbers in parenthesis following level of service are average delay per vehicle, measured in seconds, calculated with the SIDRA Intersection US HCM Model. The analysis assumed an environment factor of 1.2.
[5]Improvement Option 1 involves widening the roundabout to two circulating lanes. Two northbound lanes containing one left turn lane and one through lane would enter the roundabout. One through lane and a separate right turn lane would be provided along the southbound approach. Two eastbound lanes containing one left turn lane and one right turn lane would also enter the roundabout.

Table 2 (Continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Roundabout[6]	**LOS per JMT**
Lorewood Grove Road/Jamison Corner Road	Weekday PM
2030 Future *with Improvement Option 2*[7]	
Northbound Jamison Corner Road	B (12.7)
Southbound Lorewood Grove Road	A (7.8)
Eastbound Lorewood Grove Road	F (90.3)

Signalized Intersection[8] **(T-Intersection)**	**LOS per JMT**
Lorewood Grove Road/Jamison Corner Road	Weekday PM
2030 Future *with Improvement Option 3*[9]	D (53.9)

[6]Roundabout analysis was performed using SIDRA Intersection 5.1. The numbers in parenthesis following level of service are average delay per vehicle, measured in seconds, calculated with the SIDRA Intersection US HCM Model. The analysis assumed an environment factor of 1.2.
[7]Improvement Option 2 includes the same improvements as Option 1. However, two through lanes and a separate right turn lane would be provided along the southbound approach.
[8]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[9]Improvement Option 3 involves the installation of a traffic signal with a 120 second cycle length. In addition to a single through lane, the improvements include dual left turn lanes for the eastbound and northbound approaches and a separate right turn lane along the southbound approach.

Table 3
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Roundabout[10]	**LOS per JMT**
Southbound US 301 Ramps/ Jamison Corner Road[11]	Weekday PM
2030 Future	
Northbound Jamison Corner Road	F (187.5)
Southbound Jamison Corner Road	F (185.2)
Westbound SB US 301 Ramp	C (24.7)
2030 Future *with Improvement Option 1*[12]	
Northbound Jamison Corner Road	B (13.6)
Southbound Jamison Corner Road	F (127.2)
Westbound SB US 301 Ramp	C (22.8)
2030 Future *with Improvement Option 2*[13]	
Northbound Jamison Corner Road	B (13.6)
Southbound Jamison Corner Road	B (14.9)
Westbound SB US 301 Ramp	C (22.8)

[10]Roundabout analysis was performed using SIDRA Intersection 5.1. The numbers in parenthesis following level of service are average delay per vehicle, measured in seconds, calculated with the SIDRA Intersection US HCM Model. The analysis assumed an environment factor of 1.2.
[11]This one lane roundabout is proposed to be constructed as part of the DelDOT US 301 project.
[12]Improvement Option 1 involves two circulating lanes in the roundabout. Two northbound lanes containing one shared through/left turn lane and one through lane would enter the roundabout. Two southbound lanes containing one through lane and one right turn lane would also enter the roundabout. One entering lane would be provided along the westbound approach.
[13]Improvement Option 2 includes the same improvements as Option 1. However, two southbound lanes containing one through lane and one shared through/right turn lane would enter the roundabout.

Table 3 (Continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[14]	**LOS per JMT**
Westbound US 301 Ramps/ Jamison Corner Road	Weekday PM
2030 Future *with Improvement Option 3*[15]	D (37.6)

[14]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[15]Improvement Option 3 involves the installation of a traffic signal with a 120 second cycle length. One left turn lane and one through lane would be provided along the northbound approach, one through lane and one right turn lane would be provided along the southbound approach, and one shared left turn/right turn lane would be provided along the westbound approach.

Table 4
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Roundabout[16]	**LOS per JMT**
Northbound US 301 Ramps/ Jamison Corner Road[17]	Weekday PM
2030 Future	
Northbound Jamison Corner Road	F (642.3)
Southbound Jamison Corner Road	F (55.0)
Eastbound NB US 301 Ramp	D (29.8)
2030 Future *with Improvement Option 1*[18]	
Northbound Jamison Corner Road	F (85.7)
Southbound Jamison Corner Road	F (55.0)
Eastbound NB US 301 Ramp	C (15.5)
2030 Future *with Improvement Option 2*[19]	
Northbound Jamison Corner Road	C (17.5)
Southbound Jamison Corner Road	A (9.3)
Eastbound NB US 301 Ramp	C (16.1)

[16]Roundabout analysis was performed using SIDRA Intersection 5.1. The numbers in parenthesis following level of service are average delay per vehicle, measured in seconds, calculated with the SIDRA Intersection US HCM Model. The analysis assumed an environment factor of 1.2.
[17]This one lane roundabout is proposed to be constructed as part of the DelDOT US 301 project.
[18]Improvement Option 1 involves two circulating lanes in the roundabout. Two northbound lanes containing one through lane and one shared through/right turn lane would enter the roundabout. One entering lane would be provided along the southbound and eastbound approaches.
[19]Improvement Option 2 would also involve two circulating lanes in the roundabout. Two through lanes and a separate right turn lane would be provided along the northbound approach. One shared through/left turn lane and one through lane would be provided along the southbound approach. One entering lane would be provided along the eastbound approach.

Table 4 (Continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[20]	**LOS per JMT**
Northbound US 301 Ramps/ Jamison Corner Road	Weekday PM
2030 Future *with Improvement Option 3*[21]	D (54.4)

[20]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[21]Improvement Option 3 involves the installation of a traffic signal with a 120 second cycle length. One through lane and one right turn lane would be provided along the northbound approach, one left turn lane and one through lane would be provided along the southbound approach, and one shared left turn/right turn lane would be provided along the eastbound approach.

Table 5
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[22]	**LOS per JMT**
Summit Bridge Road/Boyds Corner Road/ Churchtown Road	Weekday PM
2013 Existing	D (39.3)
2030 Future[23]	D (48.3)

[22]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[23]The existing lane configurations and 140 second cycle length traffic signal were maintained during this analysis. However, the splits were optimized taking into account the future volumes.

Table 6
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Unsignalized Intersection[24] (T-Intersection)	**LOS per JMT**
Boyds Corner Road/Ratledge Road	Weekday PM
2013 Existing[25]	
Southbound Ratledge Road	C (18.1)
Eastbound Boyds Corner Road - Left	A (8.7)
2030 Future[26]	
Southbound Ratledge Road	F (880.7)
Eastbound Boyds Corner Road - Left	C (15.7)

Signalized Intersection[24]	**LOS per JMT**
Boyds Corner Road/Ratledge Road	Weekday PM
2030 Future[26,27,28]	C (32.0)

[24]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[25]Based upon field conditions, the eastbound approach contains a bypass lane. As such, the approach has been modeled in HCS with one left turn lane and one through lane.
[26]The modification of the southbound approach to provide a separate left turn and right turn lane and the modification of the eastbound approach to provide a separate left turn lane and a separate through lane are off-site improvements associated with the Pleasanton development. The westbound approach would maintain the existing configuration of a separate through lane and a separate right turn lane.
[27]The installation of a traffic signal at this intersection is an off-site improvement associated with the Bayberry Town Center development. JMT has analyzed the intersection with a 120 second cycle length. The improvements include the roadway modifications that would be completed as part of the Pleasanton development.
[28]Based on a conflict factor analysis, the eastbound left turn movement was modeled with a protected/permissive phasing.

Table 7
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[29]	**LOS per JMT**
Boyds Corner Road/Cedar Lane Road	Weekday PM
2013 Existing	A (9.5)

Unsignalized Intersection[29] **(T-Intersection)**	**LOS per JMT**
Boyds Corner Road/Jamison Corner Road	Weekday PM
2013 Existing	
Southbound Jamison Corner Road	C (18.8)
Eastbound Boyds Corner Road - Left	A (8.9)

[29]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.

Table 7 (Continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[30]	**LOS per JMT**
Boyds Corner Road/Jamison Corner Road/ Cedar Lane Road	Weekday PM
2030 Future[31,32]	D (52.5)

[30]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[31]As part of the DelDOT Jamison Corner Road and Boyds Corner Road projects, Cedar Lane Road and Jamison Corner Road will be aligned with each other and be controlled by a 120 second cycle traffic signal. Additional improvements include the provision of two left turn lanes, two through lanes, and one right turn lane along the eastbound and westbound approaches as well as the provision of one left turn lane, one through lane, and one right turn lane along the northbound and southbound approaches.
[32]Since Cedar Lane Road and Jamison Corner Road will be aligned with each other along Boyds Corner Road under future conditions, JMT did not use right-turn-on-red volumes and instead modeled the right turn movements as permissive within the signal phasing. Additionally, the northbound right turn lane was modeled as a free flow movement due to the presence of a long acceleration lane.

Table 8
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[33]	**LOS per JMT**
Boyds Corner Road/Town Center Drive/West Central Park Drive[34]	Weekday PM
2030 Future	D (44.2)

[33]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[34]This signalized intersection is proposed to be constructed as part of the Boyds Corner Road project as well as part of the Bayberry Town Center and Bayberry South developments. One left turn lane, two through lanes, and one right turn lane would be provided along the eastbound and westbound approaches. One left turn lane, one shared through/left turn lane, and one right turn lane would be provided along the northbound and southbound approaches.

Table 9
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[35]	**LOS per JMT**
Boyds Corner Road/North Bayberry Parkway/South Bayberry Parkway[36]	Weekday PM
2030 Future	C (30.8)

[35]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[36]This signalized intersection is proposed to be constructed as part of the Boyds Corner Road project as well as part of the Bayberry Town Center and Bayberry South developments. One left turn lane, two through lanes, and one right turn lane would be provided along the eastbound and westbound approaches. One left turn lane, one shared through/left turn lane, and one right turn lane would be provided along the northbound and southbound approaches.

Table 10
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Unsignalized Intersection[37] (T-Intersection)	**LOS per JMT**
Boyds Corner Road/Shallcross Lake Road[38]	Weekday PM
2013 Existing	
Northbound Shallcross Lake Road	C (24.0)
Westbound Boyds Corner Road - Left	A (8.7)

Unsignalized Intersection[37] (T-Intersection)	**LOS per JMT**
Boyds Corner Road/Milford Drive	Weekday PM
2013 Existing	
Southbound Milford Drive	C (21.9)
Westbound Boyds Corner Road - Left	A (9.2)

[37]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[38]Based upon field conditions, the westbound approach contains a bypass lane. As such, the approach has been modeled in HCS with one left turn lane and one through lane.

Table 10 (Continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[39]	**LOS per JMT**
Boyds Corner Road/Milford Drive/ Shallcross Lake Road[40]	Weekday PM
2030 Future	D (36.2)

[39]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[40]As part of the DelDOT Boyds Corner Road project, Shallcross Lake Road and Milford Drive will be aligned with each other and be controlled by a 120 second cycle traffic signal. Additional improvements include the provision of one left turn lane, two through lanes, and one right turn lane along the eastbound and westbound approaches as well as the provision of one left turn lane, one through lane, and one right turn lane along the northbound and southbound approaches.

Table 11
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[41]	**LOS per JMT**
Boyds Corner Road/Entrance to Boyds Corner Farm[42]	Weekday PM
2030 Future	C (23.9)

[41]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[42]This signalized intersection is proposed to be constructed as part of the Boyds Corner Farm development. Two through lanes and one right turn lane would be provided along the eastbound approach, one left turn lane and two through lanes would be provided along the westbound approach, and two left turn lanes and one right turn lane would be provided along the northbound approach.

Table 12
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Signalized Intersection[43]	**LOS per JMT**
US Route 13/Boyds Corner Road/ Pole Bridge Road	Weekday PM
2013 Existing	D (43.4)
2030 Future	F (157.6)
2030 Future *with Improvement Option 1*[44]	F (132.8)
2030 Future *with Improvement Option 2*[45]	E (79.9)
2030 Future *with Improvement Option 3*[46]	E (63.6)

[43]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[44]Improvement Option 1 involves the modification of the westbound approach to provide one left turn lane, two through lanes, and one right turn lane. As a result of the modification, the split phase signal phasing along the eastbound and westbound approaches would be removed and the eastbound and westbound left turn movements would operate concurrent with each other during a protected phase.
[45]Improvement Option 2 involves the improvements shown in Option 1, but with an additional southbound through lane. Also, right-turn-on-red volumes were not applied along the eastbound and southbound approaches, instead modeled within the phasing as permitted movements due to the presence of long acceleration lanes.
[46]Improvement Option 3 involves the improvements shown in Option 2, but with triple northbound left turn lanes and the use of a 140 second cycle length traffic signal.

Table 13
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Unsignalized Intersection[47] (All-Way Stop Controlled)	**LOS per JMT**
Marl Pit Road/Cedar Lane Road	Weekday PM
2013 Existing	
Northbound Cedar Lane Road	B (13.8)
Southbound Cedar Lane Road	C (20.3)
Eastbound Marl Pit Road	C (15.5)
Westbound Marl Pit Road	C (16.4)
2030 Future	
Northbound Cedar Lane Road	F (99.2)
Southbound Cedar Lane Road	F (593.5)
Eastbound Marl Pit Road	F (232.5)
Westbound Marl Pit Road	F (125.8)

[47]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.

Table 13 (Continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Roundabout[48]	**LOS per JMT**
Marl Pit Road/Cedar Lane Road[49]	Weekday PM
2030 Future *with Improvement Option 1*[50]	
Northbound Cedar Lane Road	C (20.5)
Southbound Cedar Lane Road	D (29.9)
Eastbound Marl Pit Road	E (45.5)
Westbound Marl Pit Road	C (18.1)

Signalized Intersection[51]	**LOS per JMT**
Marl Pit Road/Cedar Lane Road[49]	Weekday PM
2030 Future *with Improvement Option 2*[52,53]	C (30.3)

[48]Roundabout analysis was performed using SIDRA Intersection 5.1. The numbers in parenthesis following level of service are average delay per vehicle, measured in seconds, calculated with the SIDRA Intersection US HCM Model. The analysis assumed an environment factor of 1.2.
[49]The modification of this intersection to either be a roundabout or to have a traffic signal installed is an off-site improvement associated with the Pleasanton, Scott Run Business Park, Cedar Lane, Bayberry Town Center, Bayberry North, and Bayberry South developments. JMT has reviewed both options as part of this analysis.
[50]Improvement Option 1 involves a single lane roundabout with separate southbound and eastbound right turn lanes.
[51]For signalized and unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds.
[52]Improvement Option 2 involves a traffic signal with a 120 second cycle length. The improvements include separate left turn lanes along each approach to the intersection.
[53]Based on a conflict factor analysis, the eastbound and westbound left turn movements were modeled with a protected/permissive phasing.

IV. SEGMENT LOS ANALYSIS

General HCS Analysis Comments

(See table footnotes on the following pages for specific comments)

1. JMT used HCS+T7F, Version 5.5 for the analysis.

2. For future conditions, JMT used a peak hour factor of 0.95 to be consistent with future roadway characteristics.

3. For future conditions, JMT used a heavy vehicle percentage consistent with the guidelines provided in the *DelDOT Standards and Regulations for Subdivision Streets and State Highway Access.*

4. Under future conditions the alignment along Cedar Lane Road will be improved, which should increase the sight distance. As a result, JMT used a 50% no-passing zone to take into consideration the creation of passing zones along Cedar Lane Road.

5. The LOS Criteria for a two-lane Class II highway is shown below:

LOS	Class II Highways PTSF (%)
A	≤ 40
B	> 40-55
C	>55-70
D	>70-85
E	>85

LOS F applies whenever a directional peak hour volume would exceed the capacity of one direction of traffic along a two-lane highway (1,700 pc/h) per Highway Capacity Manual (HCM) standards.

Table 14
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Final Traffic Analysis for
Southern New Castle County-Transportation Investment District
Prepared by JMT

Two-Way Segment Analysis[54]	**V/C Ratio**	**PTSF**	**LOS**
Roadway	**Weekday PM 2030 Future**		
Cedar Lane Road (Between Marl Pit Road and Boyds Corner Road)	0.59	84.8	D

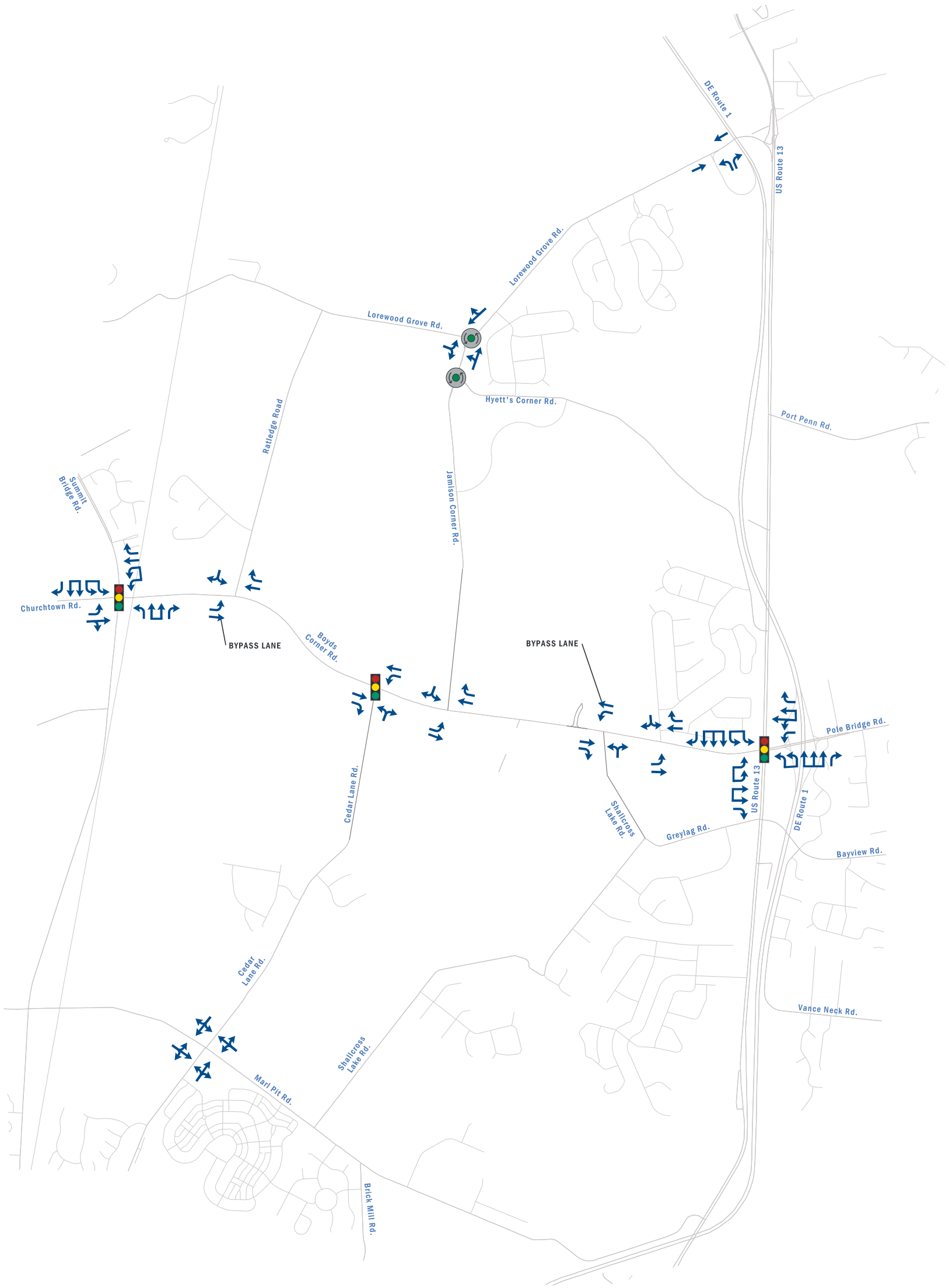
[54] For segment analyses, PTSF is percent time spent following and V/C is volume to capacity ratio.

Appendix A

Intersection Configuration Diagrams

FIGURE A1

FIGURE NOT TO SCALE



LEGEND

SIGNALIZED INTERSECTION

ROUNDABOUT INTERSECTION

JOHNSON, MIRMIRAN & THOMPSON

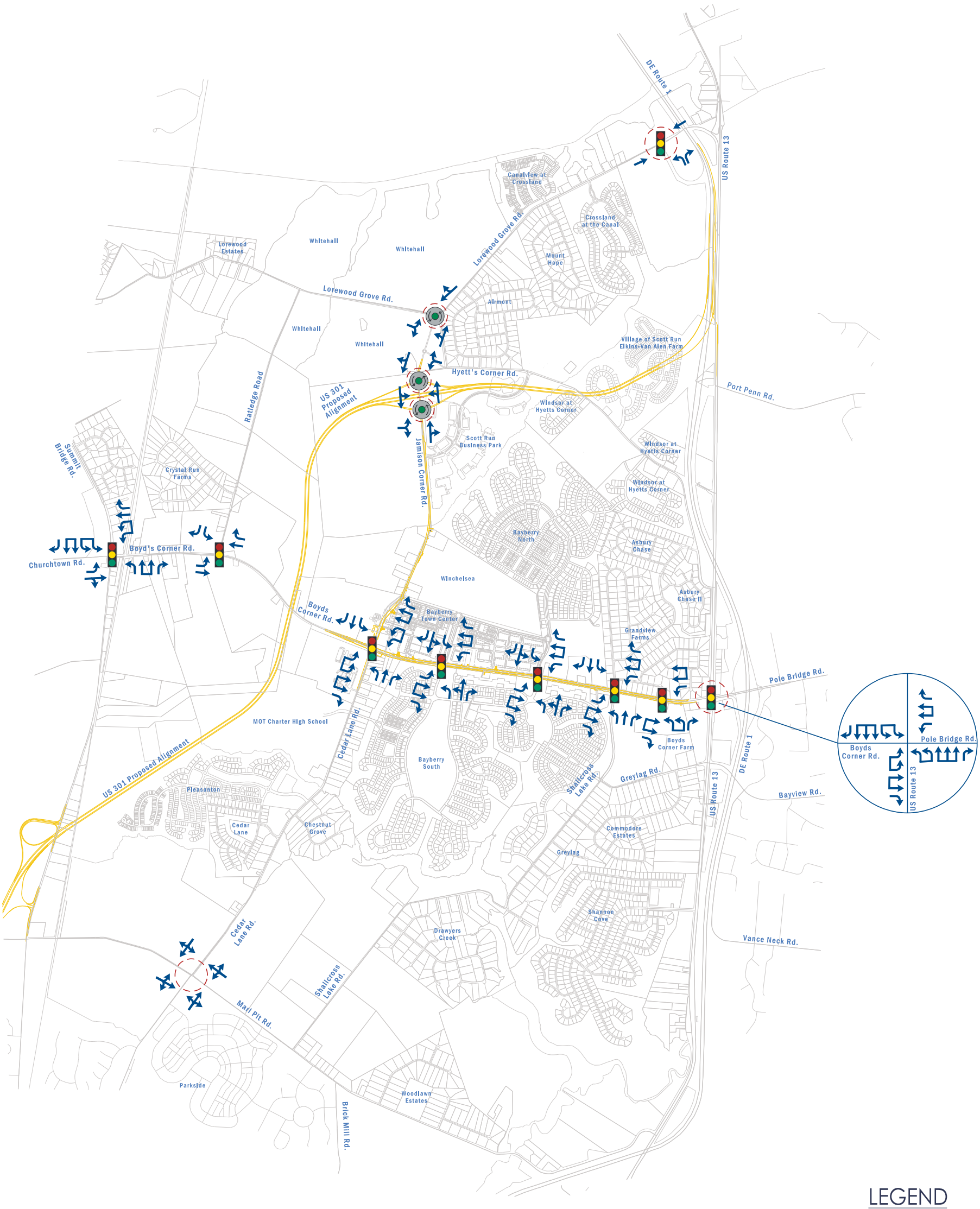
Engineering A Brighter Future®

2013 - EXISTING INTERSECTION CONFIGURATIONS

SOUTHERN NEW CASTLE COUNTY TID

FIGURE A2

FIGURE NOT TO SCALE



LEGEND

- SIGNALIZED INTERSECTION
- ROUNDABOUT INTERSECTION
- FAILING INTERSECTION

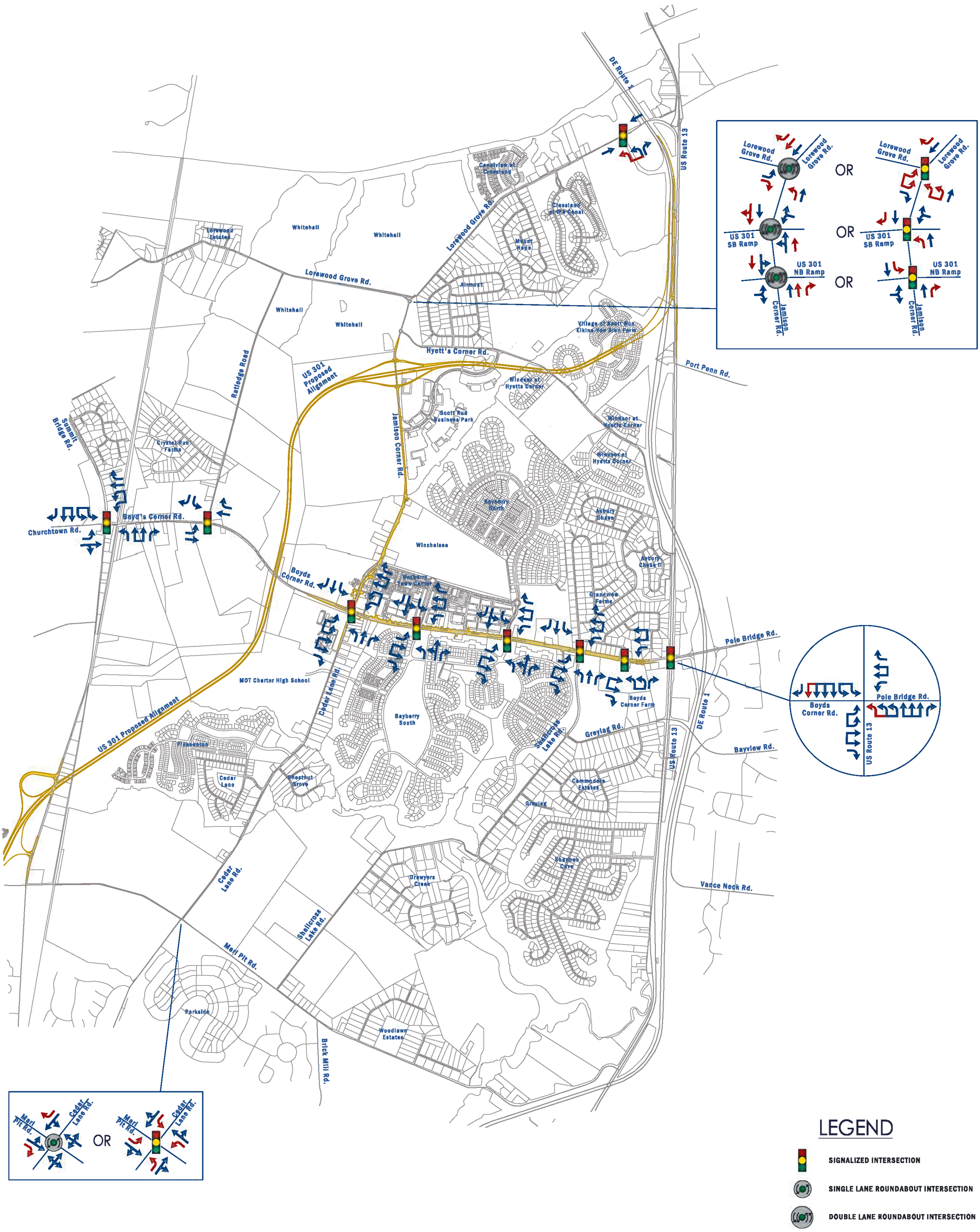
JOHNSON, MIRMIRAN & THOMPSON
Engineering A Brighter Future®

2030 - INTERSECTION CONFIGURATIONS

SOUTHERN NEW CASTLE COUNTY TID

FIGURE A3

FIGURE NOT TO SCALE



JOHNSON, MIRMIRAN & THOMPSON

Engineering A Brighter Future®

2030 - PROPOSED INTERSECTION CONFIGURATIONS

SOUTHERN NEW CASTLE COUNTY TID

Appendix B

Committed Developments

Land Use Information and Trip Generation

Southern New Castle County Transportation Investment District
Committed and Potential Developments Included in TID Analysis

	Development	Land Use	Status as of September 2013
1	**MOT Charter High School**	104,000 SF (incl. 13,000 SF assembly)/35 classrooms/ 750 students/75 employees	Not Built
2	**Shannon Cove a.k.a. Cromwell**	410 Single-Family Detached Houses	*131 Houses Built
3	**Bayberry South**	580 Single-Family Detached Houses 100 Townhouses 389 Age-Restricted Single-Family Detached Houses 120 Age-Restricted Apartment Condos	Not Built
4	**Canalview at Crossland**	285 Single-Family Detached Houses 22 Twin Houses 125 Townhouses	*94 Single-Family Houses, 22 Twin Houses and 26 Townhouses Built
5	**Crossland at the Canal**	223 Single-Family Detached Houses	*122 Single-Family Houses Built
6	**Cedar Lane**	77 Single-Family Detached Houses	Under Construction
7	**Whitehall Scott Run Business Park**	1,720,000 SF Office 104,000 SF Commercial	Not Built
8	**Pleasanton**	179 Single Family Detached Houses 68 Twin Houses	Not Built
9	**Boyds Corner Farm (Coburn Farm)**	98,800 SF Commercial 48,000 SF Office 116 Single Family Detached Houses	
10	**Winchelsea**	181 Single Family Detached Houses 44 Twin Houses 134 Townhouses 154 Apartments	Not Built
11	**Bayberry Town Center**	150 Single-Family Detached Houses (From TIS) 150 Townhouses (From TIS) 300 Apartments (From TIS) 178,960 SF of General Office Space 61,650 SF Athletic Club 381,594 SF of Retail 38,500 SF of High-Turnover Restaurant (250 Seats)	Not Built
12	**Bayberry North**	557 Single-Family Detached Houses 100 Townhouses 60 Twin Houses	*30 Single-Family Houses and 33 Townhouses Built
13	**Boyd's Corner/Shops at Parkway Motel**	13,500 SF Retail	Not Built
14	****Whitehall**	Village 1: 64,350 SF Commercial 14,950 SF Office 36 Single-Family Detached Houses 39 Townhouses 179 Apartments 299 Student Middle Schoool/Junior High School Village 2: 265 Single-Family Detached Houses 180 Apartments Hamlet 3: 213 Single-Family Detached Houses Hamlet 4: 310 Single-Family Detached Houses Village 5: 575 Single-Family Detached Houses 300 Apartments Village 6: 655 Single-Family Detached Houses 325 Apartments Hamlet 7: 217 Single-Family Detached Houses	Not Built
15	**Village of Scott Run/Elkins-Van Alen Farm**	81 Single Family Detached Houses	Not Built
16	**Windsor at Hyetts Corner**	149 Single-Family Detached Houses	*23 Single-Family Houses Built
17	**Huber's Crossing**	119,385 SF Shopping Center	Not Built
18	**Parkside**	492 Single Family Detached Houses	***184 Single-Family Houses Built

*The partially built information is approximate as provided by New Castle County on September 29, 2013 or based on the New Castle County GIS map.
**Land Use information is from the Vandemark & Lynch, Inc. 7/22/2013 Major Land Development Plan
***The partially built information was provided by the Town of Middletown on October 30, 2013.
=Under Construction

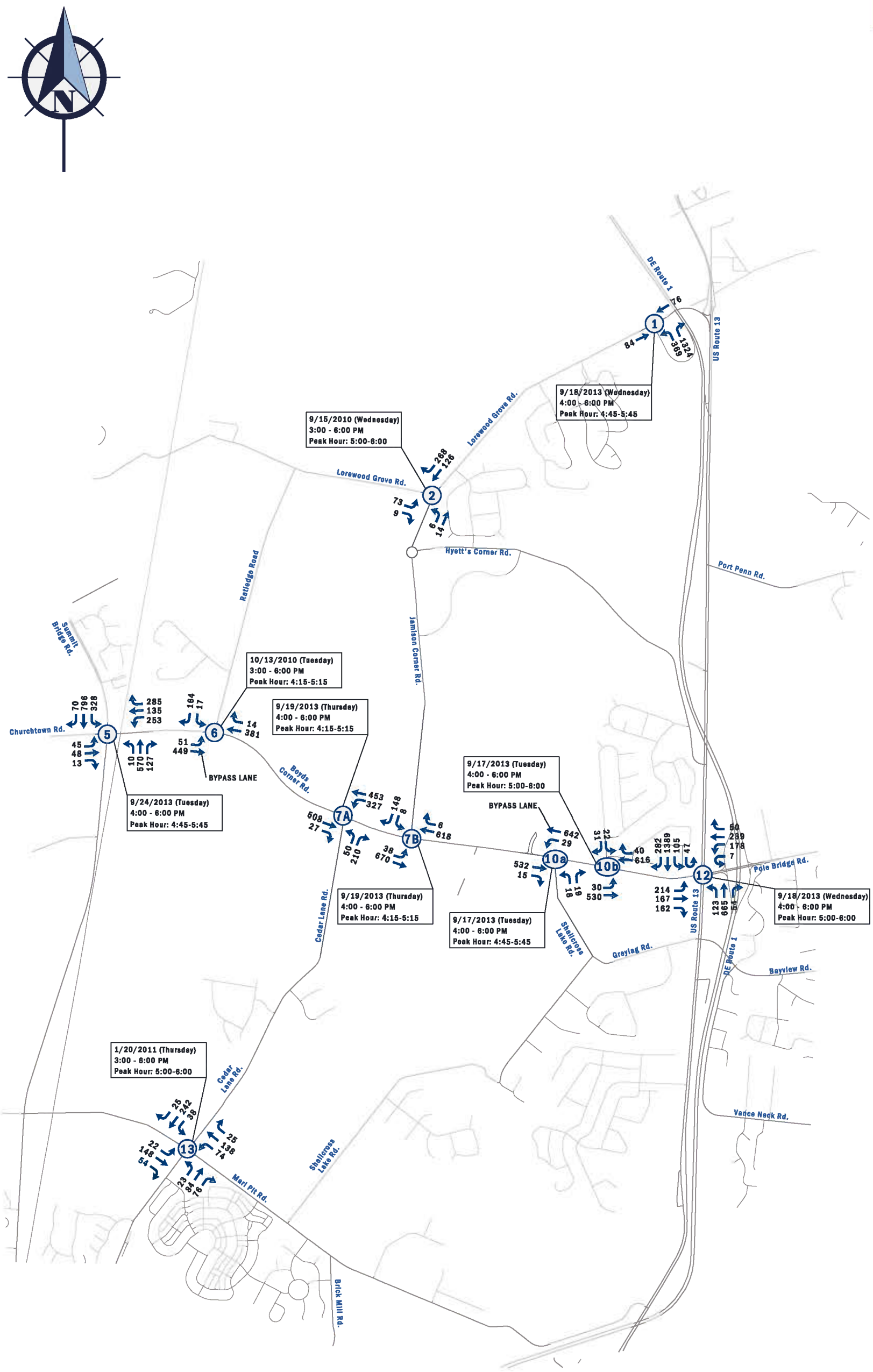
	Committed Development	Land Use	ITE Code		Development Size	Weekday 24-Hour Calculation	Enter	Exit	Total	Weekday PM Peak Calculation	Enter	Exit	Total
1	MOT Charter High School	High School	530	Proposed Students	750	EXP(0.81*LN(X)+1.86)	685	685	1,370	0.13*X	46	52	98
										Net External Trips	**46**	**52**	**98**
2	Shannon Cove	Single-Family Detached Housing	210	Proposed Units	410	EXP(0.92*LN(X)+2.72)	1,923	1,923	3,846	EXP(0.9*LN(X)+0.51)	236	138	374
	a.k.a Cromwell			Built	131	EXP(0.92*LN(X)+2.72)	673	673	1,346	EXP(0.9*LN(X)+0.51)	84	50	134
				Net New Units	279		1,250	1,250	2,500		152	88	240
										Net External Trips	**152**	**88**	**240**
3	Bayberry South	Single Family Detached Housing	210	Proposed Units	580	EXP(0.92*LN(X)+2.72)	2,646	2,646	5,292	EXP(0.9*LN(X)+0.51)	322	189	511
										Net External Trips	**322**	**189**	**511**
		Residential Condominium/Townhouse	230	Proposed Units	100	EXP(0.87*LN(X)+2.46)	322	321	643	EXP(0.82*LN(X)+0.32)	40	20	60
										Net External Trips	**40**	**20**	**60**
		Senior Adult Housing - Detached	251	Proposed Units	389	EXP(0.89*LN(X)+2.06)	792	792	1,584	EXP(0.75*LN(X)+0.35)	76	48	124
										Net External Trips	**76**	**48**	**124**
		Senior Adult Housing - Attached	252	Proposed Units	120	2.98*X+21.05	190	189	379	0.24*X+1.64	16	14	30
										Net External Trips	**16**	**14**	**30**
4	Canalview at Crossland	Single Family Detached Housing	210	Proposed Units	285	EXP(0.92*LN(X)+2.72)	1,377	1,376	2,753	EXP(0.9*LN(X)+0.51)	170	100	270
				Built	94	EXP(0.92*LN(X)+2.72)	496	496	992	EXP(0.9*LN(X)+0.51)	62	37	99
				Net New Units	**191**		**881**	**880**	**1,761**		**108**	**63**	**171**
										Net External Trips	**108**	**63**	**171**
		Residential Condominium/Townhouse	230	Proposed Units	147	EXP(0.87*LN(X)+2.46)	450	449	899	EXP(0.82*LN(X)+0.32)	55	27	82
				Built	48	EXP(0.87*LN(X)+2.46)	170	170	340	EXP(0.82*LN(X)+0.32)	22	11	33
				Net New Units	**99**		**280**	**279**	**559**		**33**	**16**	**49**
										Net External Trips	**33**	**16**	**49**
5	Crossland at the Canal	Single Family Detached Housing	210	Proposed Units	223	EXP(0.92*LN(X)+2.72)	1,098	1,098	2,196	EXP(0.9*LN(X)+0.51)	136	80	216
				Built	122	EXP(0.92*LN(X)+2.72)	631	630	1,261	EXP(0.9*LN(X)+0.51)	79	47	126
				Net New Units	**101**		**467**	**468**	**935**		**57**	**33**	**90**
										Net External Trips	**57**	**33**	**90**
6	Cedar Lane	Single Family Detached Housing	210	Proposed Units	77	EXP(0.92*LN(X)+2.72)	413	413	826	EXP(0.9*LN(X)+0.51)	52	31	83
										Net External Trips	**52**	**31**	**83**
7	Whitehall Scott Run	Office Park	750	Proposed S.F.	1,824,000	11.42*X	10,415	10,415	20,830	1.48*X	378	2,322	2,700
	Business Park									20% Reduction Due to ROW Impacts	76	464	540
										Net External Trips	**302**	**1,858**	**2,160**
8	Pleasanton	Single Family Detached Housing	210	Proposed Units	179	EXP(0.92*LN(X)+2.72)	897	897	1,794	EXP(0.9*LN(X)+0.51)	112	65	177
										Net External Trips	**112**	**65**	**177**
		Residential Condominium/Townhouse	230	Proposed Units	68	EXP(0.87*LN(X)+2.46)	230	230	460	EXP(0.82*LN(X)+0.32)	29	15	44
										Net External Trips	**29**	**15**	**44**
9	Boyds Corner Farm	Shopping Center	820	Proposed S.F.	98,800	42.70*X	2,110	2,109	4,219	3.71*X	176	191	367
										Internal Capture	20	29	49
										Net Trips	156	162	318
										Pass-By	53	55	108
										Net External Trips	**103**	**107**	**210**
	(Coburn Farm)	General Office Building	710	Proposed S.F.	48,000	EXP(0.76*LN(X)+3.68)	376	376	752	1.12*X+78.45	22	110	132
										Internal Capture	6	6	12
										Net External Trips	**16**	**104**	**120**
		Single Family Detached Housing	210	Proposed Units	116	EXP(0.92*LN(X)+2.72)	602	602	1,204	EXP(0.9*LN(X)+0.51)	76	44	120
										Internal Capture	25	16	41
										Net External Trips	**51**	**28**	**79**
10	Winchelsea	Single Family Detached Housing	210	Proposed Units	181	EXP(0.92*LN(X)+2.72)	907	906	1,813	EXP(0.9*LN(X)+0.51)	113	66	179
										Net External Trips	**113**	**66**	**179**
		Residential Condominium/Townhouse	230	Proposed Units	178	EXP(0.87*LN(X)+2.46)	531	531	1,062	EXP(0.82*LN(X)+0.32)	64	32	96
										Net External Trips	**64**	**32**	**96**
		Apartment	220	Proposed Units	154	6.06*X+123.56	529	528	1,057	0.55*X+17.65	66	36	102
										Net External Trips	**66**	**36**	**102**
11	Bayberry Town Center	Single Family Detached Housing	210	Proposed Units	150	EXP(0.92*LN(X)+2.72)	763	762	1,525	EXP(0.9*LN(X)+0.51)	95	56	151
		Residential Condominium/Townhouse	230	Proposed Units	150	EXP(0.87*LN(X)+2.46)	458	457	915	EXP(0.82*LN(X)+0.32)	56	28	84
		Apartment	220	Proposed Units	300	6.06*X+123.56	971	971	1,942	0.55*X+17.65	119	64	183
										Total	270	148	418
										Internal Capture	89	77	166
										Net External Trips	**181**	**71**	**252**
		General Office Building	710	Proposed S.F.	178,960	EXP(0.76*LN(X)+3.68)	1,022	1,021	2,043	1.12*X+78.45	47	232	279
										Internal Capture	15	58	73
										Net External Trips	**32**	**174**	**206**
		Shopping Center	820	Proposed S.F.	381,594	EXP(0.65*LN(X)+5.83)	8,109	8,108	16,217	EXP(0.67*LN(X)+3.31)	706	764	1,470
										Internal Capture	133	131	264
										Net Trips	573	633	1,206
										Pass-By	195	215	410
										Net External Trips	**378**	**418**	**796**
		High-Turnover (Sit-Down) Restaurant	932	Proposed S.F.	38,500	127.15*X	2,448	2,447	4,895	9.85*X	227	152	379
										Internal Capture	73	44	117
										Net Trips	154	108	262
										Pass-By	66	46	112
										Net External Trips	**88**	**62**	**150**
		Recreational Community Center	493	Proposed S.F.	61,650	33.82*X	1,043	1,042	2,085	2.74*X	83	86	169
										Net External Trips	**83**	**86**	**169**
12	Bayberry North	Single Family Detached Housing	210	Proposed Units	557	EXP(0.92*LN(X)+2.72)	2,550	2,549	5,099	EXP(0.9*LN(X)+0.51)	311	182	493
				Built	30	EXP(0.92*LN(X)+2.72)	174	173	347	EXP(0.9*LN(X)+0.51)	23	13	36
				Net New Units	**527**		**2,376**	**2,376**	**4,752**		**288**	**169**	**457**
										Net External Trips	**288**	**169**	**457**
		Residential Condominium/Townhouse	230	Proposed Units	160	EXP(0.87*LN(X)+2.46)	484	484	968	EXP(0.82*LN(X)+0.32)	59	29	88
				Built	33	EXP(0.87*LN(X)+2.46)	123	122	245	EXP(0.82*LN(X)+0.32)	16	8	24
				Net New Units	**127**		**361**	**362**	**723**		**43**	**21**	**64**
										Net External Trips	**43**	**21**	**64**
13	Boyd's Corner/Shops	Shopping Center	820	Proposed S.F.	13,500	42.70*X	288	288	576	3.71*X	24	26	50
	at Parkway Motel									Pass-By	8	9	17
										Net External Trips	**16**	**17**	**33**
14	Whitehall	Village 1											
		Shopping Center	820	Proposed S.F.	64,350	42.70*X	1,374	1,374	2,748	3.71*X	115	124	239
										Internal Capture	12	19	31
										Net Trips	103	105	208
										Pass-By	35	36	71
										Net External Trips	**68**	**69**	**137**
		General Office Building	710	Proposed S.F.	14,950	EXP(0.76*LN(X)+3.68)	155	155	310	1.12*X+78.45	16	79	95
										Internal Capture	4	4	8
										Net External Trips	**12**	**75**	**87**
		Single Family Detached Housing	210	Proposed Units	36	EXP(0.92*LN(X)+2.72)	205	205	410	EXP(0.9*LN(X)+0.51)	26	16	42
		Residential Condominium/Townhouse	230	Proposed Units	39	EXP(0.87*LN(X)+2.46)	142	142	284	EXP(0.82*LN(X)+0.32)	19	9	28
		Apartment	220	Proposed Units	179	6.06*X+123.56	604	604	1,208	0.55*X+17.65	75	41	116
										Total	120	66	186
										Internal Capture	17	10	27
										Net External Trips	**103**	**56**	**159**
		Middle School/Junior High School	522	Proposed Students	299	1.62*X	242	242	484	0.16*X	24	24	48
										Net External Trips	**24**	**24**	**48**
		Village 2											
		Single Family Detached Housing	210	Proposed Units	265	EXP(0.92*LN(X)+2.72)	1,287	1,287	2,574	EXP(0.9*LN(X)+0.51)	159	94	253
										Net External Trips	**159**	**94**	**253**
		Apartment	220	Proposed Units	180	6.06*X+123.56	607	607	1,214	0.55*X+17.65	76	41	117
										Net External Trips	**76**	**41**	**117**
		Hamlet 3											
		Single Family Detached Housing	210	Proposed Units	213	EXP(0.92*LN(X)+2.72)	1,053	1,053	2,106	EXP(0.9*LN(X)+0.51)	131	77	208
										Net External Trips	**131**	**77**	**208**
		Hamlet 4											
		Single Family Detached Housing	210	Proposed Units	310	EXP(0.92*LN(X)+2.72)	1,487	1,487	2,974	EXP(0.9*LN(X)+0.51)	183	108	291
										Net External Trips	**183**	**108**	**291**
		Village 5											
		Single Family Detached Housing	210	Proposed Units	575	EXP(0.92*LN(X)+2.72)	2,625	2,625	5,250	EXP(0.9*LN(X)+0.51)	319	188	507
										Net External Trips	**319**	**188**	**507**
		Apartment	220	Proposed Units	300	6.06*X+123.56	971	971	1,942	0.55*X+17.65	119	64	183
										Net External Trips	**119**	**64**	**183**
		Village 6											
		Single Family Detached Housing	210	Proposed Units	655	EXP(0.92*LN(X)+2.72)	2,960	2,959	5,919	EXP(0.9*LN(X)+0.51)	359	211	570
										Net External Trips	**359**	**211**	**570**
		Apartment	220	Proposed Units	325	6.06*X+123.56	1,047	1,046	2,093	0.55*X+17.65	127	69	196
										Net External Trips	**127**	**69**	**196**
		Hamlet 7											
		Single Family Detached Housing	210	Proposed Units	217	EXP(0.92*LN(X)+2.72)	1,071	1,071	2,142	EXP(0.9*LN(X)+0.51)	133	78	211
										Net External Trips	**133**	**78**	**211**
15	Village of Scott Run/	Single Family Detached Housing	210	Proposed Units	81	EXP(0.92*LN(X)+2.72)	433	432	865	EXP(0.9*LN(X)+0.51)	55	32	87
	Elkins-Van Alen Farm									**Net External Trips**	**55**	**32**	**87**
16	Windsor at Hyetts Corner	Single Family Detached Housing	210	Proposed Units	149	EXP(0.92*LN(X)+2.72)	758	758	1,516	EXP(0.9*LN(X)+0.51)	95	55	150
				Built	23	EXP(0.92*LN(X)+2.72)	136	136	272	EXP(0.9*LN(X)+0.51)	18	10	28
				Net New Units	**126**		**622**	**622**	**1,244**		**77**	**45**	**122**
										20% Reduction Due to ROW Impacts	15	9	24
										Net External Trips	**62**	**36**	**98**
17	Huber's Crossing	Shopping Center	820	Proposed S.F.	119,385	EXP(0.65*LN(X)+5.83)	3,810	3,810	7,620	EXP(0.67*LN(X)+3.31)	324	351	675
										Pass-By	110	119	229
										Net External Trips	**214**	**232**	**446**
18	Parkside	Single Family Detached Housing	210	Proposed Units	492	EXP(0.92*LN(X)+2.72)	2,275	2,274	4,549	EXP(0.9*LN(X)+0.51)	278	163	441
				Built	184	EXP(0.92*LN(X)+2.72)	920	920	1,840	EXP(0.9*LN(X)+0.51)	115	67	182
				Net New Units	**308**		**1,355**	**1,354**	**2,709**		**163**	**96**	**259**
										Net External Trips	**163**	**96**	**259**

Appendix C

Traffic Volume Figures

FIGURE C1

FIGURE NOT TO SCALE



LEGEND

XX - PM PEAK HOUR VOLUMES

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EXISTING PEAK HOUR TRAFFIC VOLUMES

SOUTHERN NEW CASTLE COUNTY TID

FIGURE C2

FIGURE NOT TO SCALE

LEGEND

XX - PM PEAK HOUR VOLUMES

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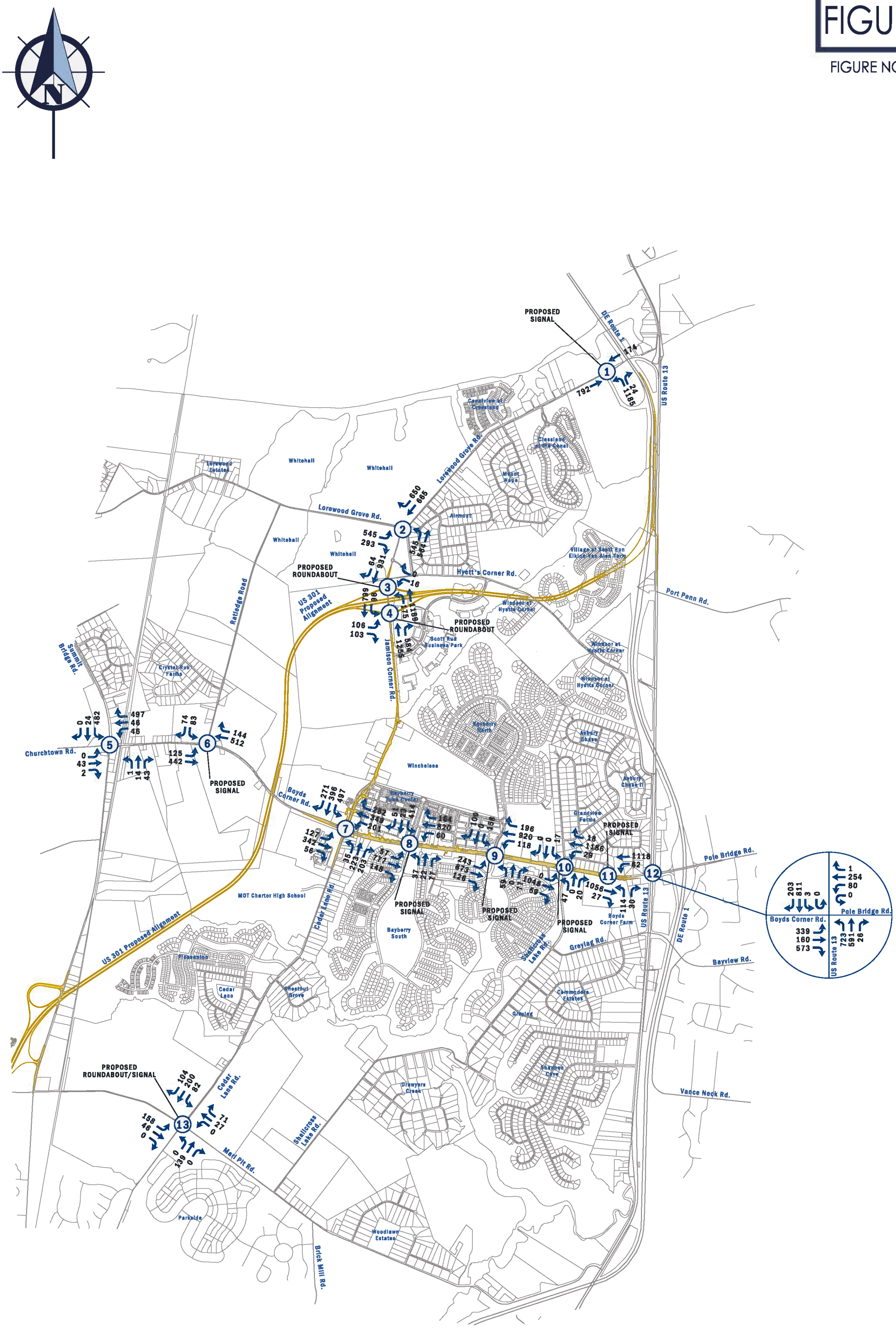
2013 - SEASONALLY ADJUSTED PEAK HOUR TRAFFIC VOLUMES

SOUTHERN NEW CASTLE COUNTY TID

FIGURE C3

FIGURE NOT TO SCALE



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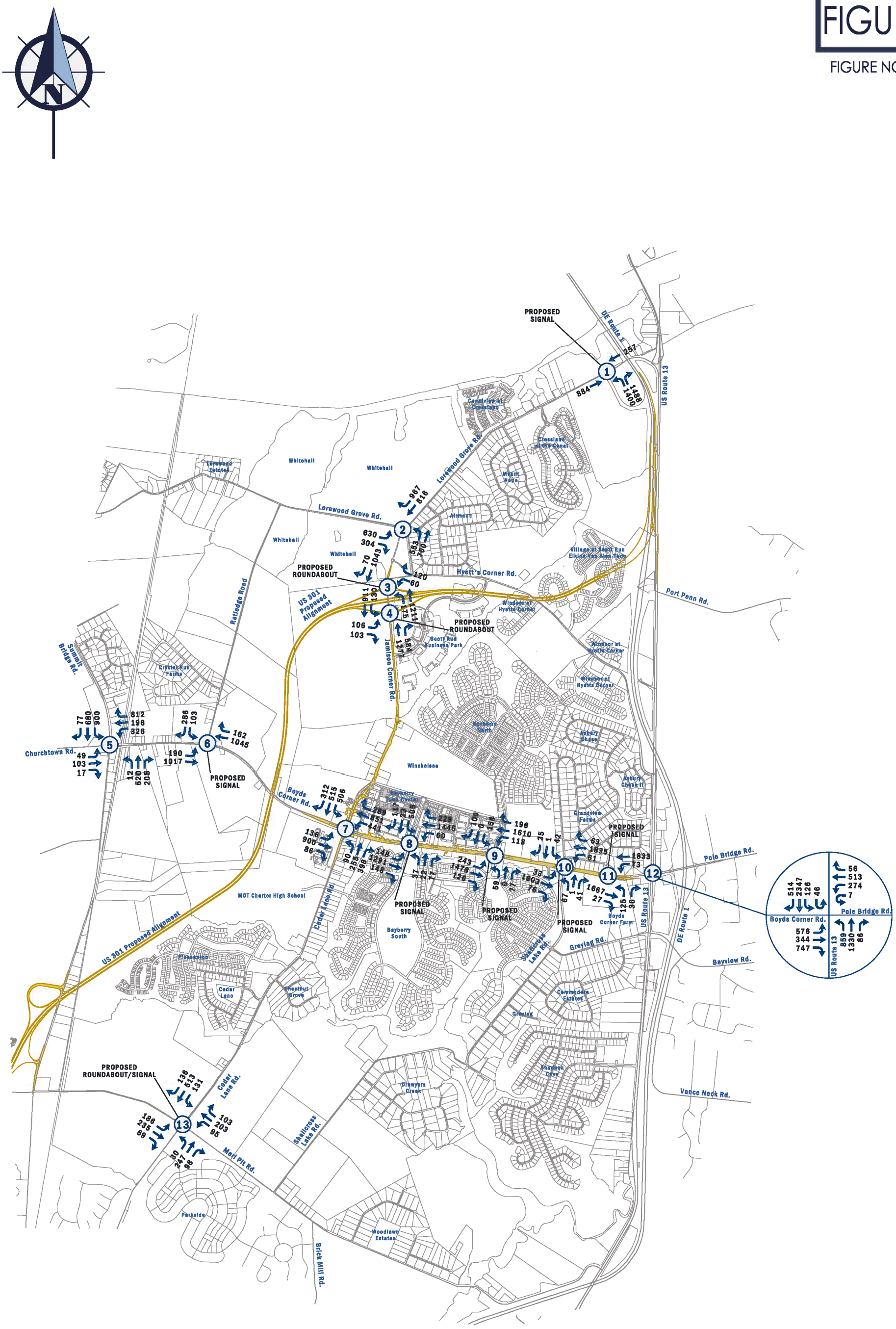
NET EXTERNAL COMMITTED DEVELOPMENT VOLUMES

SOUTHERN NEW CASTLE COUNTY TID

FIGURE C4

FIGURE NOT TO SCALE



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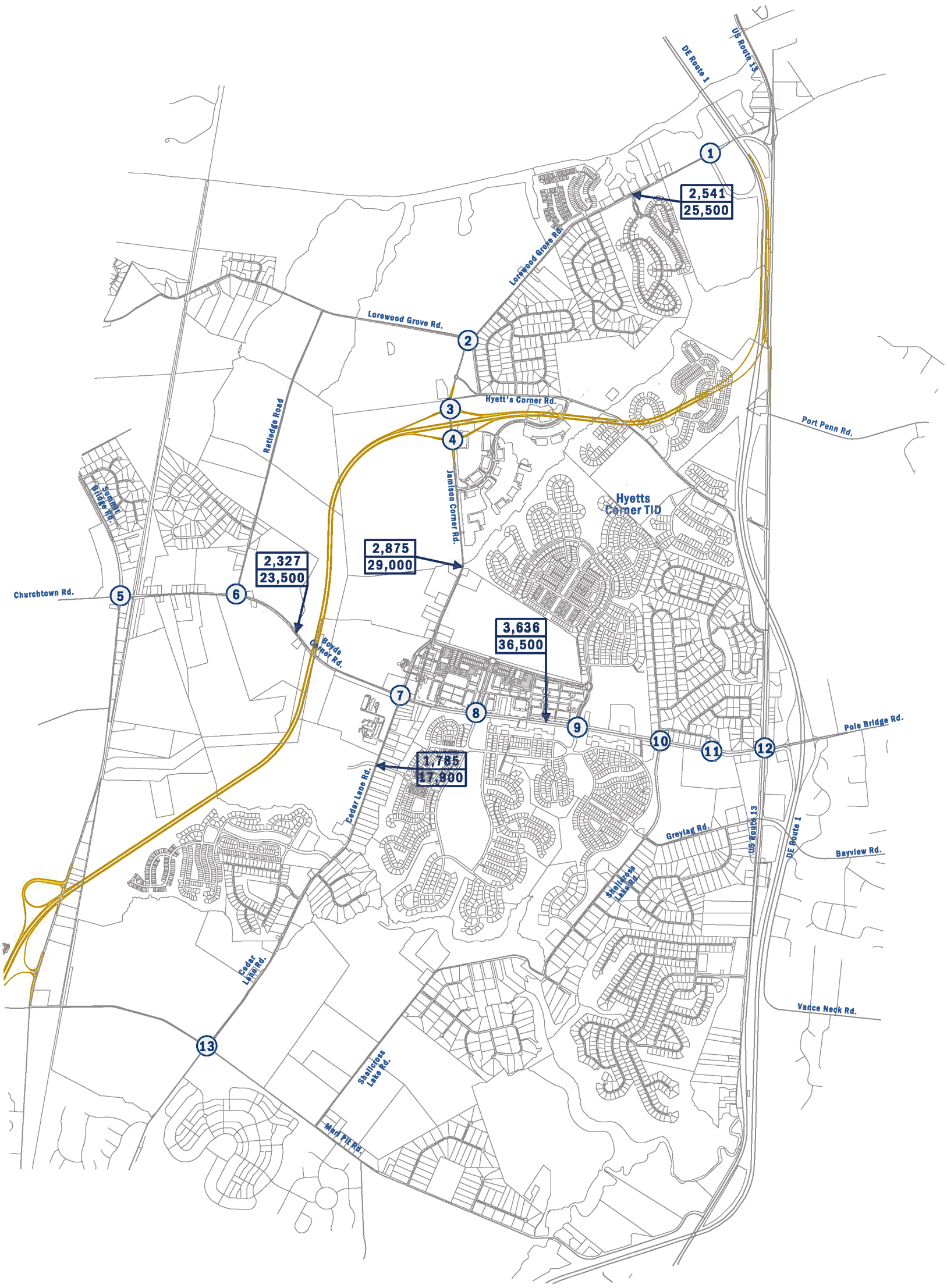
2030 - PROPOSED TOTAL TRAFFIC VOLUMES

SOUTHERN NEW CASTLE COUNTY TID

FIGURE C5

FIGURE NOT TO SCALE



LEGEND

XXX	PM PEAK HOUR TWO WAY VOLUME
XXX	ADT

NOTE: ASSUMED ADT IS BASED ON A K FACTOR OF 10

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2030 - PROJECTED AADT VOLUMES

SOUTHERN NEW CASTLE COUNTY TID

Appendix D

Segment Analysis Assumptions

Southern New Castle County TID

Segment Analysis Assumptions

A two-way segment analyses was performed for Cedar Lane Road as part of this study. Per the Highway Capacity Manual (HCM) standards two-way segment analyses are typically conducted for highway sections of at least 2.0 miles. As such, the Cedar Lane Road segment length, which is 2.09 miles, satisfies this HCM recommendation.

Cedar Lane Road (Between Intersections 7 and 13)

- Segment Length = 2.09
- Access Points = 5 Access Points (5/2.09 = 2.39 Access Points/Mile)
- 12’ Lanes
- 8’ Shoulder
- PHF = 0.95
- 6% HV
- Percent No-Passing Zones = 50%
- 45 mph BFFS
- Volume = 1,785 vph
- Directional Split = 58/42
- F (A) = Adjustment for Access-Point Density = 10/2.5 = 2.39/X….X = 0.60
- Class II Highway

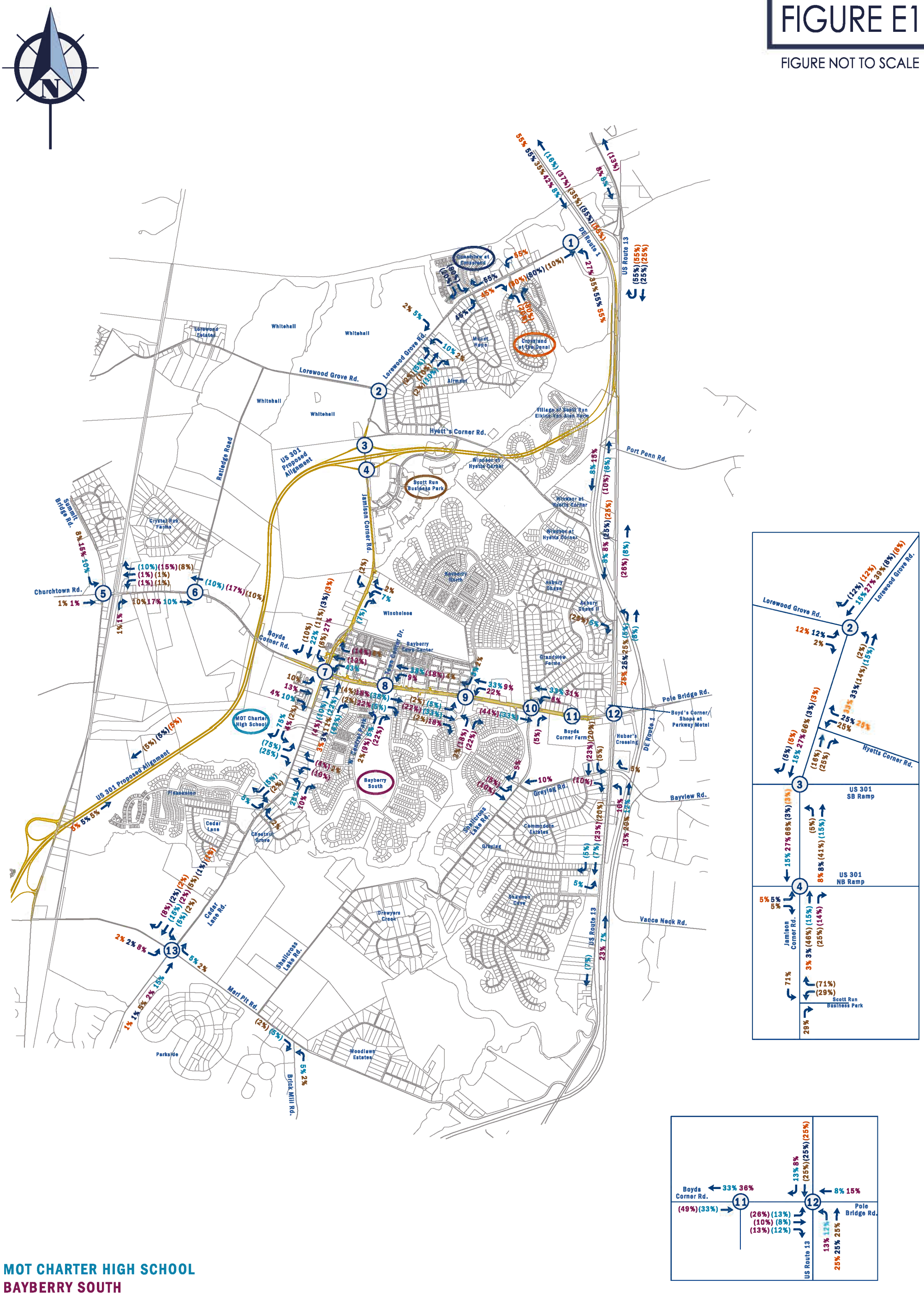
Appendix E

Committed Developments

Trip Distribution

FIGURE E1

FIGURE NOT TO SCALE



MOT CHARTER HIGH SCHOOL
BAYBERRY SOUTH
WHITEHALL SCOTT RUN BUSINESS PARK
CANALVIEW AT CROSSLAND
CROSSLAND AT THE CANAL

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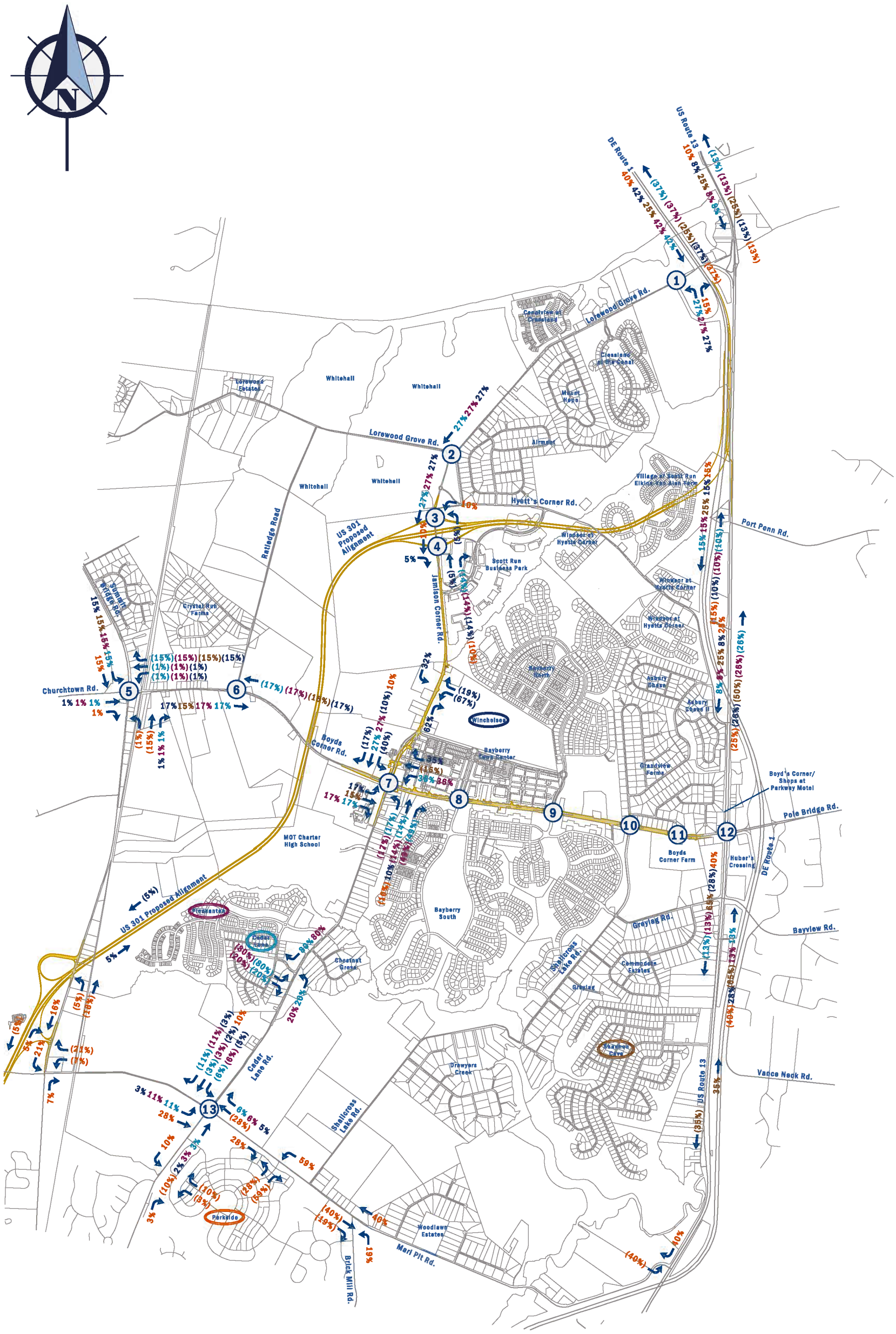
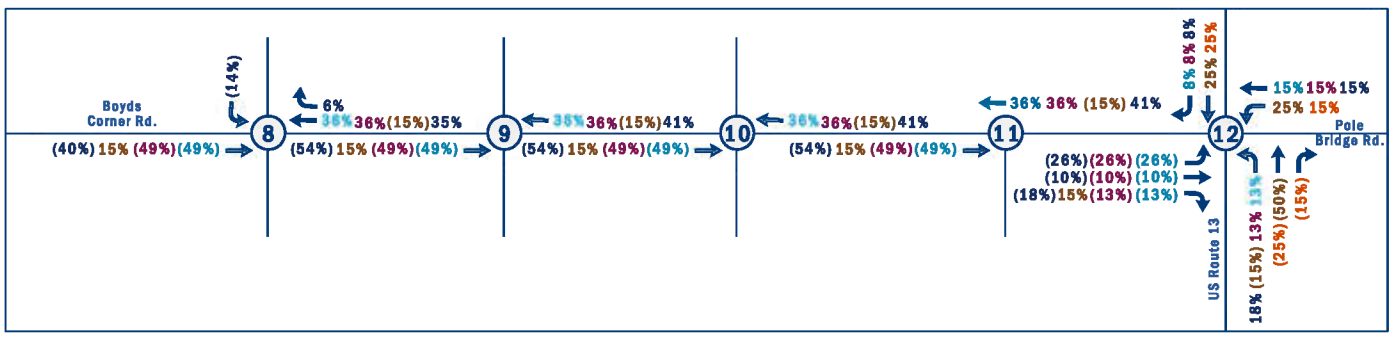
DISTRIBUTIONS FOR DEVELOPMENTS 1, 3, 4, 5 & 7

SOUTHERN NEW CASTLE COUNTY TID

FIGURE E2

FIGURE NOT TO SCALE





CEDAR LANE
PLEASANTON
CROMWELL (SHANNON COVE)
WINCHELSEA
PARKSIDE

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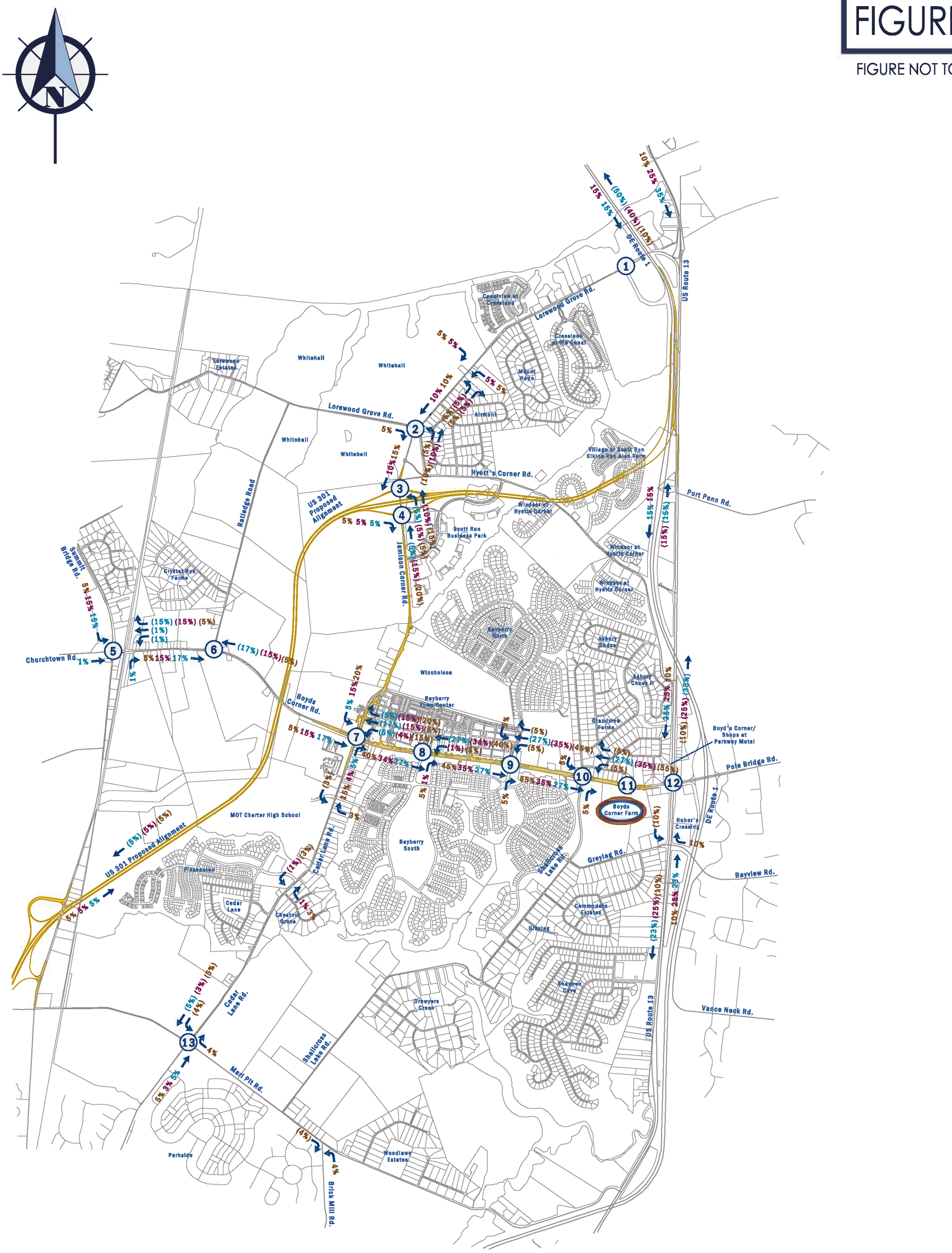
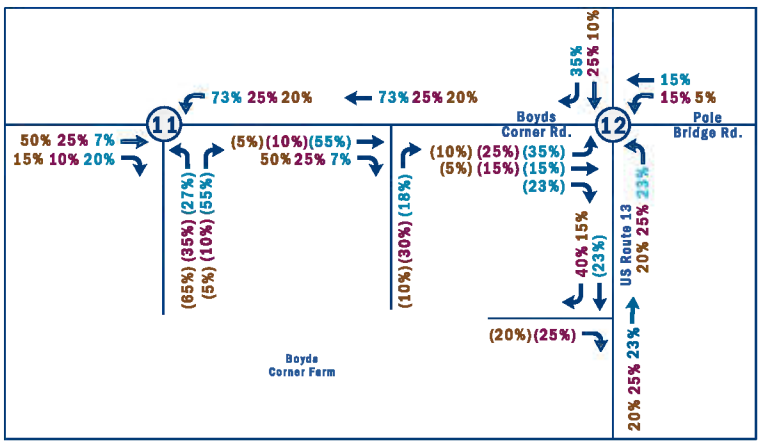
DISTRIBUTIONS FOR DEVELOPMENTS 2, 6, 8, 10 & 18

SOUTHERN NEW CASTLE COUNTY TID

FIGURE E3

FIGURE NOT TO SCALE





BOYDS CORNER FARM: RESIDENTIAL

BOYDS CORNER FARM: OFFICE

BOYDS CORNER FARM: COMMERCIAL

JOHNSON, MIRMIRAN & THOMPSON

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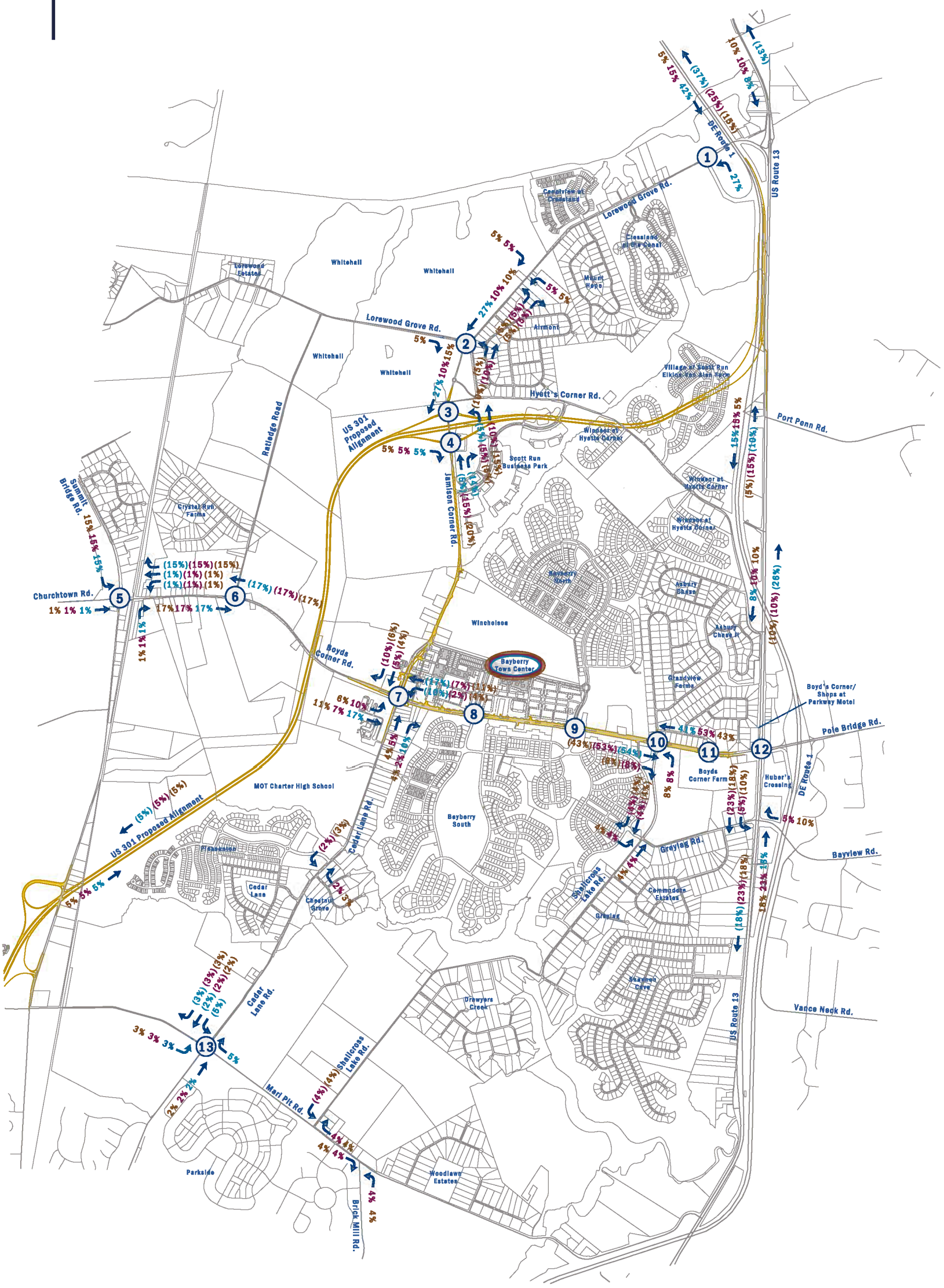
DISTRUBUTION FOR DEVELOPMENT 9
BOYDS CORNER FARM

SOUTHERN NEW CASTLE COUNTY TID

FIGURE E4

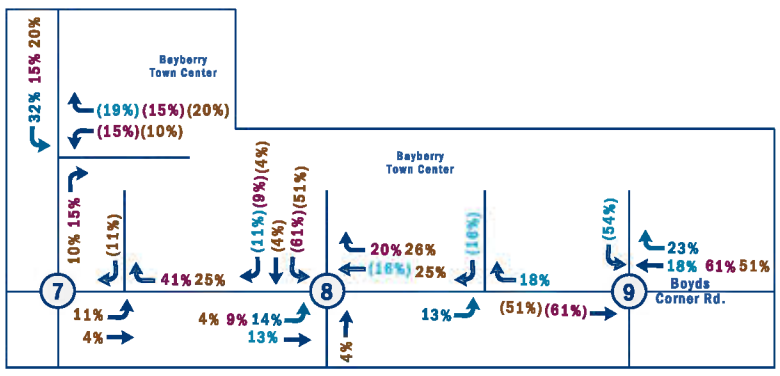
FIGURE NOT TO SCALE

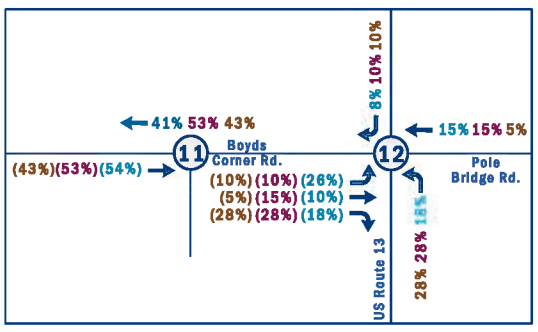


BAYBERRY TOWN CENTER: RESIDENTIAL

BAYBERRY TOWN CENTER: OFFICE

BAYBERRY TOWN CENTER: RETAIL





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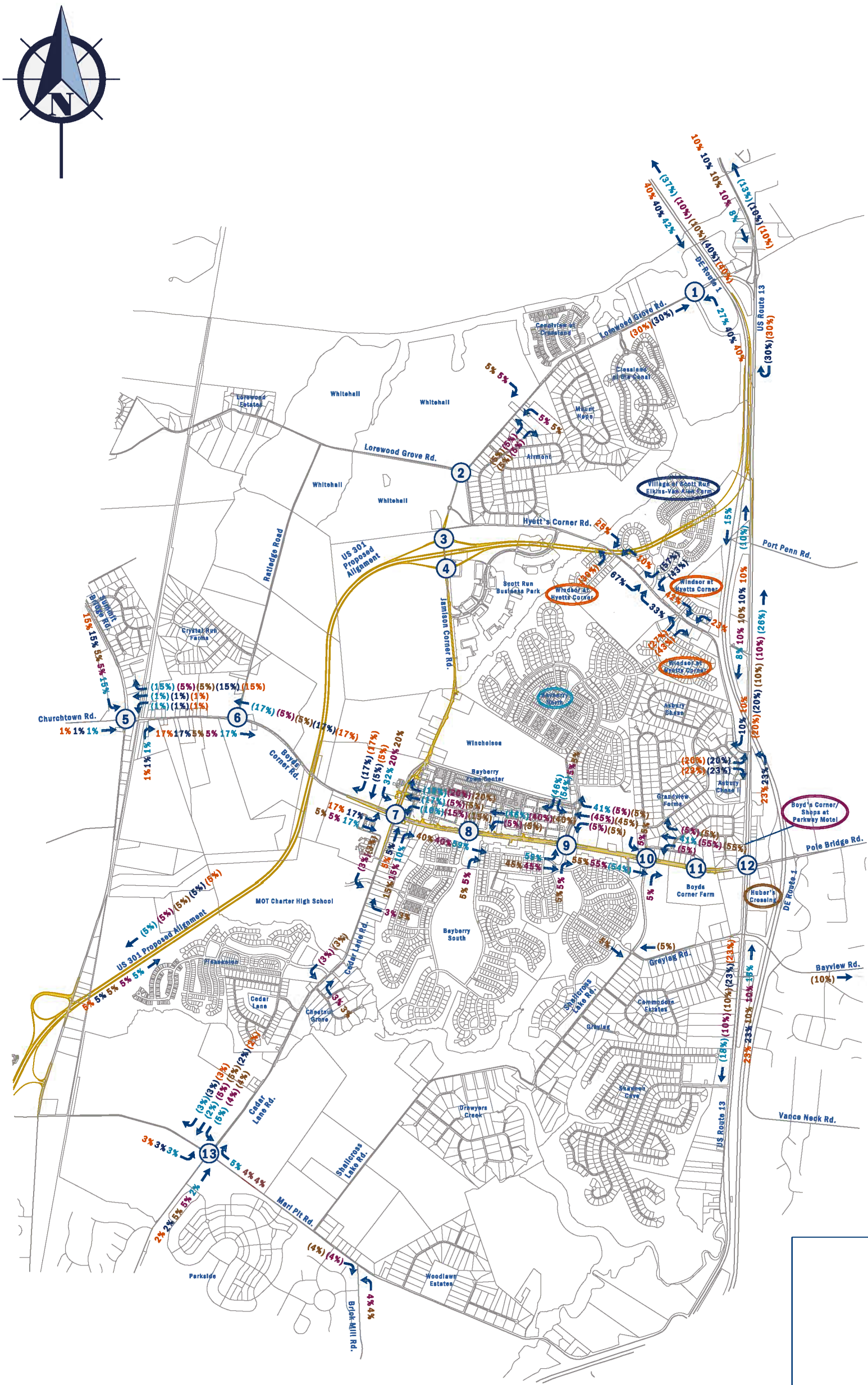
Engineering A Brighter Future®

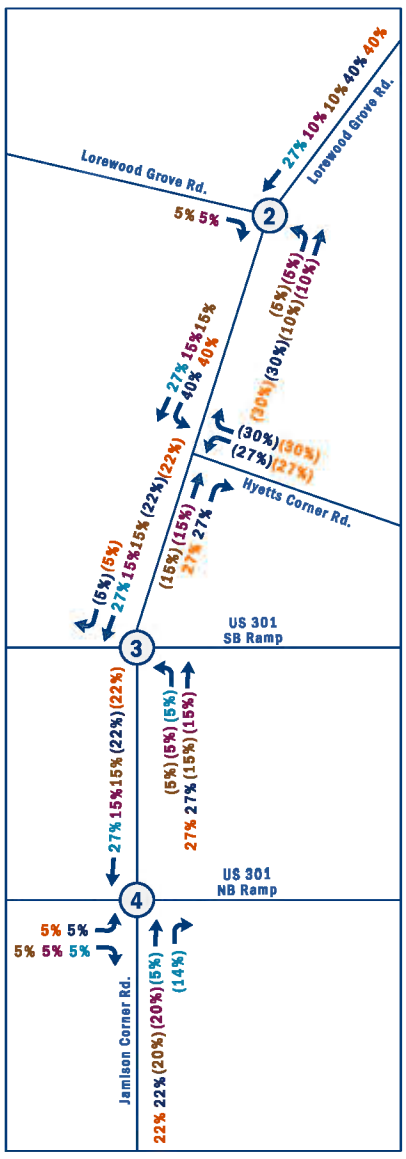
DISTRIBUTIONS FOR DEVELOPMENT 11 BAYBERRY TOWN CENTER

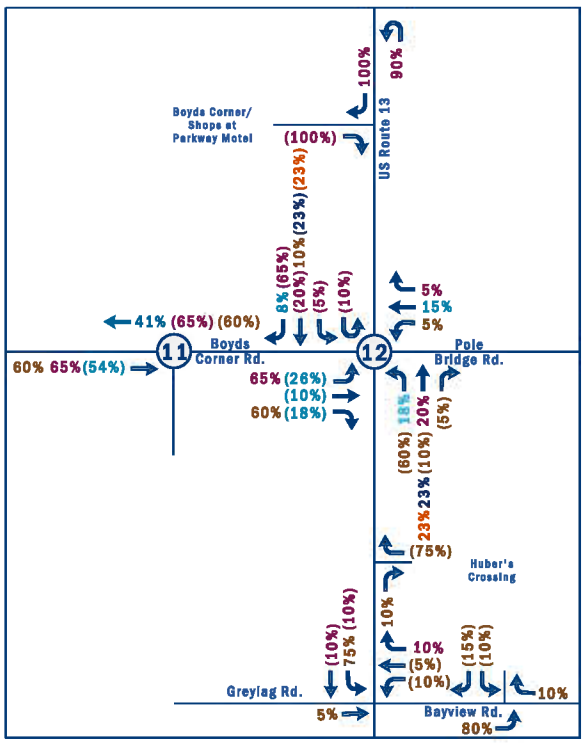
SOUTHERN NEW CASTLE COUNTY TID

FIGURE E5

FIGURE NOT TO SCALE







BAYBERRY NORTH
BOYD'S CORNER/SHOPS AT PARKWAY MOTEL
HUBER'S CROSSING
VILLAGE OF SCOTT RUN/ELKINS VAN ALEN FARM
WINDSOR AT HYETTS CORNER

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DISTRIBUTIONS FOR DEVELOPMENTS 12, 13, 15, 16 &17

SOUTHERN NEW CASTLE COUNTY TID

FIGURE E6

FIGURE NOT TO SCALE

WHITEHALL VILLAGE 1, HAMLET 3 & HAMLET 7: RESIDENTIAL DISTRIBUTION
WHITEHALL VILLAGE 1: OFFICE
WHITEHALL VILLAGE 1: RETAIL
WHITEHALL VILLAGE 1: MIDDLE SCHOOL/JUNIOR HIGH SCHOOL
WHITEHALL VILLAGE 4, 5 & 6
WHITEHALL VILLAGE 2

JOHNSON, MIRMIRAN & THOMPSON
Engineering A Brighter Future®

DISTRUBUTION FOR DEVELOPMENT 14
WHITEHALL

SOUTHERN NEW CASTLE COUNTY TID