ANNE ARUNDEL COUNTY
MARYLAND

FUTURE CONDITIONS REPORT
TRANSPORTATION FACILITIES PLANNING
RIDGE ROAD
CONTRACT #H545901

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1.0 INTRODUCTION

1.1 Project Purpose

Ridge Road is a county-maintained road in northwest Anne Arundel County, paralleling the Baltimore Washington Parkway and New Ridge Road. Project limits are Dorsey Road (MD 176) to the south and Corporate Center Drive (MD 758) to the north. The corridor serves light industrial use and commuter parking, as well as some commercial and residential development; however, much of the adjacent land is undeveloped. The roadway is generally not up to current County standards with no shoulders, bike lanes, curbs or sidewalks. Projected growth in industrial and mixed-use space, as well as the future planned connection to MD 295 (via Hanover Pkwy), is expected to result in increased travel demand in the corridor. The purpose of the Ridge Road transportation facility planning study is to identify future year 2040 deficiencies, evaluate build alternatives to address deficiencies, improve travel in the corridor by reducing current and forecasted congestion, reduce crash potential, improve pedestrian and bicycle compatibility, while minimizing impacts to the natural and built environment. The final product of this study is a vetted conceptual design that can be advanced into Final Design.

1.2 Executive Summary

The findings and recommendations for the Ridge Road transportation facilities planning study are as follows:

- By Year 2040, traffic volumes are expected to double along the corridor to approximate 5,000 ADWT.
- Expected growth along the length of the corridor will result in the following study intersections operating at a LOS E or worse overall during weekday AM or weekday PM peak hour under the No-Build 2040 scenario:
  - Ridge Road at Hanover Road
  - Additionally, the southbound left-through-right lane at Stoney Run Road will exhibit failing conditions during the PM peak hour, though the intersection as a whole will not.
- A preferred design concept was developed that includes the following:
  1. Due to low projected year 2040 ADWT and peak hour volumes, no changes to the typical roadway lane configuration are proposed along the corridor with the exception of the Hanover Road intersection. The roadway is recommended to remain two lanes.
  2. Minor intersection improvements include:
     a. Adding dedicated northbound left- and southbound right-turn lanes at Hanover Road to accommodate increases in vehicle trips due to the proposed Hanover Road Extension and interchange at MD 295
     b. Changing the stop control at Stoney Run Road from an existing four-way stop to two-way stop control on the east-west legs.
     c. Lengthening the southbound right turn bay along Ridge Road at the intersection of New Ridge Road from 175 feet to 300 feet.
- To improve pedestrian connectivity in the area, a new continuous sidewalk is proposed on both the east and west sides of Ridge Road from Dorsey Road to Corporate Drive.

- Bicycle improvements recommended for the 2040 design year include continuous on-road bike lanes along the east and west sides of Ridge Road between New Ridge Road and Corporate Center Drive.
- Stormwater improvements include 8-feet wide dual swales on both the east and west sides of the roadway from New Ridge Road to Corporate Center Drive.
- During Final Design, vertical and horizontal roadway curvature should be reviewed to insure that it meets County standards for the current design speed of the road.
- The total amount of new right-of-way and easement acquisition required under the recommended design for year 2040 is about 5.5 acres.
- The estimated construction cost for the recommended design is $8 million.

1.3 Study Area Location and Limits

The study corridor consists of Ridge Road from Dorsey Road (MD 176) to Corporate Center Drive. The following five intersections were included in the study:

1. Ridge Road at Corporate Center Drive
2. Ridge Road at Hanover Road
3. Ridge Road at Stoney Run Road
4. Ridge Road at New Ridge Road
5. Ridge Road at Dorsey Road (MD 176)

A base map of the study area is shown in Figure 1.

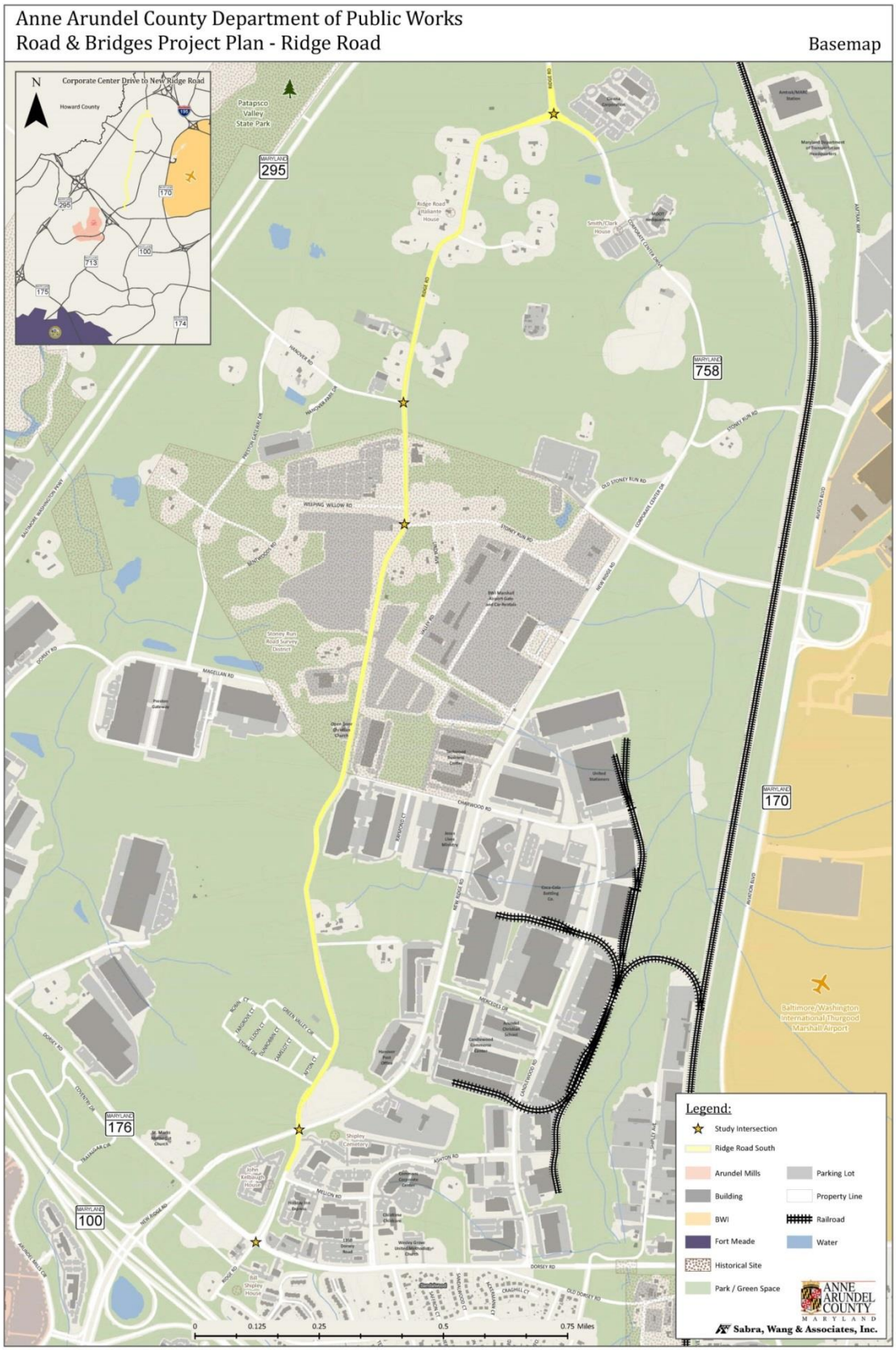


Figure 1: Study Area Base Map

2.0 EXISTING CONDITIONS

This section highlights relevant data and observations, collected for the *Existing Conditions Report,* that were used to develop and define the future year geometry and typical cross-sections[1].

2.1 Roadway Characteristics

Ridge Road is a two-way, undivided, county-maintained minor arterial roadway that extends from Ridge Commons Blvd in the south to Furnace Avenue, just north of MD-295. The Ridge Road study corridor is between New Ridge Road and Corporate Center Drive. It is two lanes wide, with typical lanes that are ten to twelve-feet wide with no paved or unpaved shoulder. No curb and gutter is present. The posted speed limit is 35 mph. The existing ADT along Ridge Road is about 2,800 vehicles.

2.2 Pedestrian and Bicycle Facilities

While there are no dedicated bike lanes, a signed bike route runs along Ridge Road between Stoney Run Rd and Hanover Rd, which is near the BWI trail, which provides a direct connection to the Baltimore & Annapolis Trail.

Sidewalks are located on both the east and west side of Ridge Road between Dorsey Rd (MD 176) and New Ridge Rd. There are no sidewalks along Ridge Road between MD 176 and Corporate Center Dr. Table 1 summarizes the existing pedestrian amenities by intersection.

Table 1: Pedestrian Amenities

#	Intersection	Pedestrian Amenities					
		Sidewalks	Marked Crosswalks	Pedestrian Signals	Push Buttons to Cross	Pedestrian Refuge	Ramps
1	Ridge Rd at Corporate Center Drive	East side of North leg Shared path on North side of East leg	East	No	No	East	No
2	Ridge Rd at Hanover Rd	None	n/a	n/a	n/a	n/a	n/a
3	Ridge Rd at Stoney Run Rd	None	n/a	n/a	n/a	n/a	n/a
4	Ridge Rd at New Ridge Rd	East and West side of South leg North and South side of East leg	South and East	Yes	Yes	No	Non-compliant ramps on South and East legs
5	Ridge Rd at MD 176	All except South side of West leg and North side of East leg	Old worn-out markings on East leg	No	Yes	No	Non-compliant ramps on East leg

[1] All collected and observational data can be found in the previously-issued *Existing Conditions* Report.

2.3 Crash Data Analysis

Three years of crash data was provided for the period from January 1, 2012 to December 31, 2014. A total of 15 police-reported intersection crashes occurred along this segment over the three-year time frame. The crashes are summarized below and in Table 2**.**

- Three crashes (20%) resulted in injury, and twelve crashes (80%) only involved property damages. No crashes were fatal.
- Three (3) injuries occurred in the three (3) crashes involving injuries.
- No crashes involved pedestrians.
- Angle collisions were the most common type, with eight (53%) collisions, followed by sideswipe collisions, with thirty-seven (20%) crashes.

Table 2: Crash Data Summary

#	Intersection	Year	Accident Type				Total Accidents
			Angle	Rear End	Sideswipe	Fixed Object	
1	Ridge Rd at Corporate Center Dr	2012	-	-	-	-	0
		2013	-	-	-	-	0
		2014	-	-	-	1	1
		Total	**0**	**0**	**0**	**1**	1
2	Ridge Rd at Hanover	2012	-	-	-	-	0
		2013	-	-	-	-	0
		2014	-	-	-	-	0
		Total	**0**	**0**	**0**	**0**	0
3	Ridge Rd at Stoney Run Rd	2012	-	-	-	-	0
		2013	1	-	-	-	1
		2014	3	-	-	-	3
		Total	**4**	**0**	**0**	**0**	4
4	Ridge Rd at New Ridge Rd	2012	-	-	-	-	0
		2013	-	-	1	-	1
		2014	-	1	-	-	1
		Total	**0**	**1**	**1**	**0**	2
5	Ridge Rd at Dorsey Rd (MD 176)	2012	-	1	-	1	2
		2013	2	-	-	-	2
		2014	2	-	2	-	4
		Total	**4**	**1**	**2**	**1**	**8**

2.3.1 Safety Recommendations

A review of the total crashes throughout the corridor (e.g. including at non-intersection locations) showed a total of 28 crashes from Dorsey Road to Corporate Center Drive[2].

- 10 corridor-wide crashes resulted in injuries
- ¼ of the crashes were fixed-object crashes.
- None were fatal

The high number of fixed object crashes can likely be attributed to the changes in the horizontal curvature, in conjunction with the lack of curbs and close proximity of trees and utility poles to the roadway edge line. While there are some short-term improvements to address changes in horizontal curvature – such as raised pavement markings, and additional warning signage[3] and markings, and improved lighting, the recommended 2040 build design will include the addition of curbs and buffers from utility poles and trees, which will decrease the likelihood of accidents involving fixed-objects. Additionally, because Ridge Road is a designated bike route, the posted speed limit should be maintained at 35 mph or lower. Similarly, any geometric improvements should not increase the design speed of the corridor.

Finally, during Final Design, vertical and horizontal roadway curvature should be reviewed to insure that it meets County standards for the current design speed of the road

[2] The time frame was from January 1, 2012 through October 31, 2015

[3]

2.4 Existing Capacity Analysis

Weekday AM and PM peak period traffic data was collected in late August and early September midweek, when school was in session, between 7:00 and 9:00 AM and 4:00 to 7:00 PM for the study intersections. Saturday peak period data was not collected due to the industrial nature of the land use and lack of retail. These volumes were entered into a validated Synchro model, whose imbedded Highway Capacity Manual (HCM) software was then used to analyze existing intersection capacity. Performance measures of effectiveness include level of service (LOS), volume-to-capacity (v/c) ratio, and average vehicle delay. A Critical Lane Volume (CLV) analysis was also performed for a planning-level analysis. Sidra™ roundabout software was used to analyze the intersection of Ridge Road and MD 758 (Corporate Center Drive). The results of the existing conditions capacity analysis, shown in Table 3, indicate that no intersections operate below the Anne Arundel County threshold for acceptable LOS during the weekday AM or PM peak hours[4]. Similarly, no individual turning movements operate at a failing LOS or exceed capacity. According to the CLV analysis, all study intersection operate at a LOS A during the AM and PM peak hours. Accordingly, no short-term traffic improvements were recommended in the *Existing Conditions* Report. Detailed CLV worksheets and Synchro HCM reports are in Appendix B and C, respectively.

In addition to capacity analysis, queuing was assessed using SimTraffic, Synchro's companion software. Queuing throughout the network was minimal during the weekday morning and evening peak hours, as shown in Table 3.

[4] The Anne Arundel County standard for the minimum acceptable Level of Service is D or a CLV of 1450. Intersections found to be operating below LOS D will require mitigation.

Table 3: Existing Intersection Capacity Analysis Results

#	Intersection	Movement	Existing Conditions AM (PM)						
			Delay/Veh (sec)	Level of Service	Volume/ Capacity Ratio	Critical Lane Volume	Level of Service	Volume/ Capacity Ratio	95th Queues
1	Ridge Rd at Corporate Center Dr*	**Overall**	**3.7 (4.1)**	**A (A)**	**0.07 (0.11)**	**Roundabout CLV Analysis Not Applicable**			- (-)
		EB	3.8 (3.7)	A (A)	0.06 (0.05)				9 (7)
		NB	3.8 (4.1)	A (A)	0.07 (0.09)				13 (17)
		SB	3.6 (4.3)	A (A)	0.04 (0.11)				4 (13)
2	Ridge Rd at Hanover**	**Overall**	**6.8 (7.4)**	**- (-)**	**- (-)**	**282 (590)**	**A (A)**	**0.18 (0.37)**	- (-)
		EBLR	9.7 (11.4)	A (B)	0.16 (0.29)				56 (69)
		NBLT	5.6 (7.0)	A (A)	0.07 (0.21)				12 (60)
		SBTR	0.0 (0.0)	A (A)	0.02 (0.06)				0 (3)
3	Ridge Rd at Stoney Run Rd**	**Overall**	**7.7 (8.6)**	**- (-)**	**- (-)**	**245 (367)**	**A (A)**	**0.15 (0.23)**	- (-)
		EBL	7.0 (8.0)	A (A)	0.00 (0.00)				0 (0)
		EBTR	6.3 (7.4)	A (A)	0.00 (0.00)				16 (11)
		WBL	7.7 (8.0)	A (A)	0.06 (0.05)				37 (34)
		WBTR	6.6 (7.5)	A (A)	0.09 (0.17)				41 (52)
		NBLTR	7.8 (8.7)	A (A)	0.12 (0.22)				50 (61)
		SBLTR	8.3 (9.3)	A (A)	0.16 (0.27)				51 (56)
4	Ridge Rd at New Ridge Rd	**Overall**	**7.6 (8.0)**	**A (A)**	**0.20 (0.22)**	**320 (440)**	**A (A)**	**0.20 (0.27)**	- (-)
		EBLTR	2.7 (2.8)	A (A)	0.20 (0.18)				67 (87)
		WBLTR	2.4 (2.7)	A (A)	0.10 (0.2)				62 (85)
		NBL	24.2 (24.9)	C (C)	0.07 (0.21)				9 (21)
		NBT	25.2 (24.4)	C (C)	0.26 (0.16)				28 (18)
		NBR	24.0 (23.8)	C (C)	0.04 (0.03)				13 (10)
		SBLT	24.6 (25.5)	C (C)	0.16 (0.34)				32 (59)
		SBR	24.0 (23.8)	C (C)	0.04 (0.05)				36 (37)
5	Ridge Rd at Dorsey Rd	**Overall**	**11.3 (13.8)**	**B (B)**	**0.53 (0.42)**	**763 (651)**	**A (A)**	**0.48 (0.41)**	- (-)
		EBL	4.4 (5.7)	A (A)	0.07 (0.11)				57 (47)
		EBTR	9.0 (8.5)	A (A)	0.52 (0.32)				161 (108)
		WBL	5.1 (6.4)	A (A)	0.17 (0.06)				45 (31)
		WBTR	6.5 (9.8)	A (B)	0.22 (0.4)				80 (128)
		NBLT	33.7 (39.4)	C (D)	0.37 (0.64)				73 (125)
		NBR	31.1 (29.5)	C (C)	0.02 (0.03)				39 (43)
		SBL	37.1 (31.9)	D (C)	0.54 (0.32)				85 (74)
		SBT	31.3 (29.6)	C (C)	0.07 (0.05)				36 (40)
		SBR	31.2 (29.5)	C (C)	0.03 (0.03)				0 (0)

* Roundabout Intersection

** Stop Controlled Intersection

3.0 YEAR 2040 FUTURE NO-BUILD CONDITIONS

3.1 Year 2040 No-Build Roadway Network

The only planned roadway improvement along the Ridge Road corridor is the extension and widening of Hanover Road. These roadway improvements are associated with the planned interchange at Hanover Road and the Baltimore/Washington Parkway[5]. The following improvements are in the planning state for the Hanover Road and Ridge Road intersection:

- The addition of an eastern leg as the extension of Hanover Road, through to New Ridge Road (see Figure 2)[6]
- Signalization
- Widening of Hanover Road

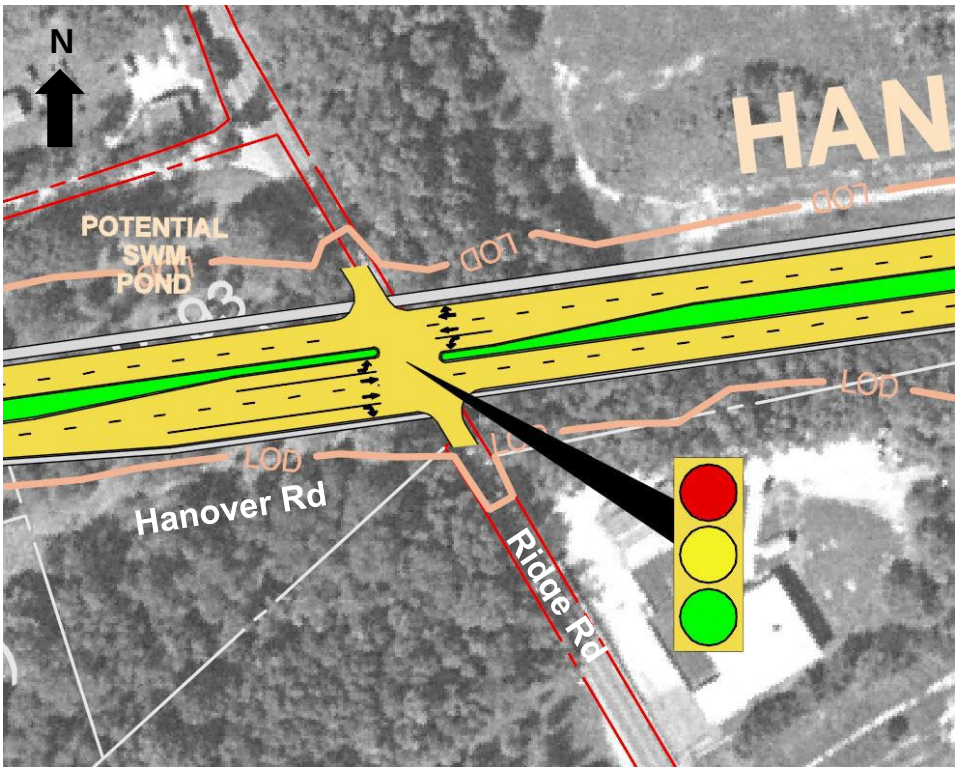


Figure 2: Proposed intersection lane configuration along Hanover Road (extended).

3.2 Year 2040 Traffic Volumes

A travel demand forecasting analysis was performed to estimate both regional and local growth along the Ridge Road corridor by future year 2040. This analysis utilized the Baltimore Metropolitan Council's (BMC) Travel 4.4 model to estimate Average Weekday Daily Traffic (AWDT) for the Ridge Road corridor and the surrounding roadway network for years 2017 and 2040.

[5] The Hanover Road interchange at MD 295 is not currently in BMC's Maximize 2040 Plan, however, its inclusion is this study was requested by Anne Arundel County.

[6] MD 295 Planning Study, Project Planning Division, MD SHA December 2007

A subarea analysis was performed to generate AWDT counts with a higher level of detail for the study area. The subarea network improvements were validated using actual AWDT counts and those counts generated by the original BMC model runs. A more detailed summary of the travel demand forecasting analysis is located in Appendix A.

Future year 2040 turning movement counts were estimated by post processing the AWDT counts generated from the subarea analysis based upon processing methods outlined in the National Cooperative Highway Research Program (NCHRP) Report 255 and 765. Post processing starts by calculating growth rates between the existing 2017 and the future 2040 model outputs for each AWDT within the study area. The growth rates for each turning movement in the corridor are then calculated by averaging the growth rates for the origin and destination links of each turning movement. Once growth rates for each turning movement are applied at each study intersection, the volumes within the network are balanced. Post processing is repeated for each future peak hour studied. Future year 2040 intersection counts for the morning and evening peak hours can be found in Figure 3 and Figure 4, respectively.

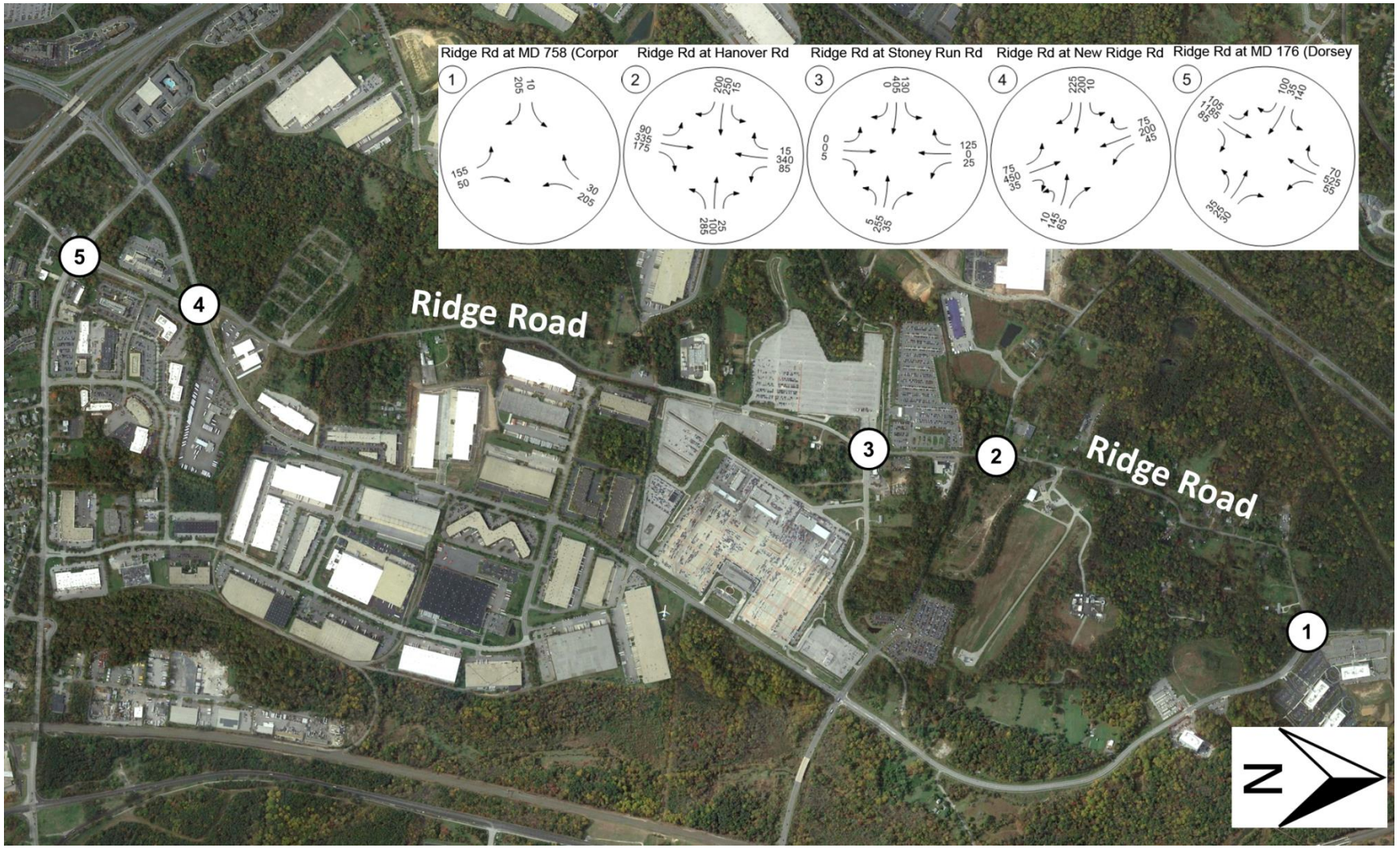


Figure 3: Future Year 2040 AM Peak Hour Intersection Volumes

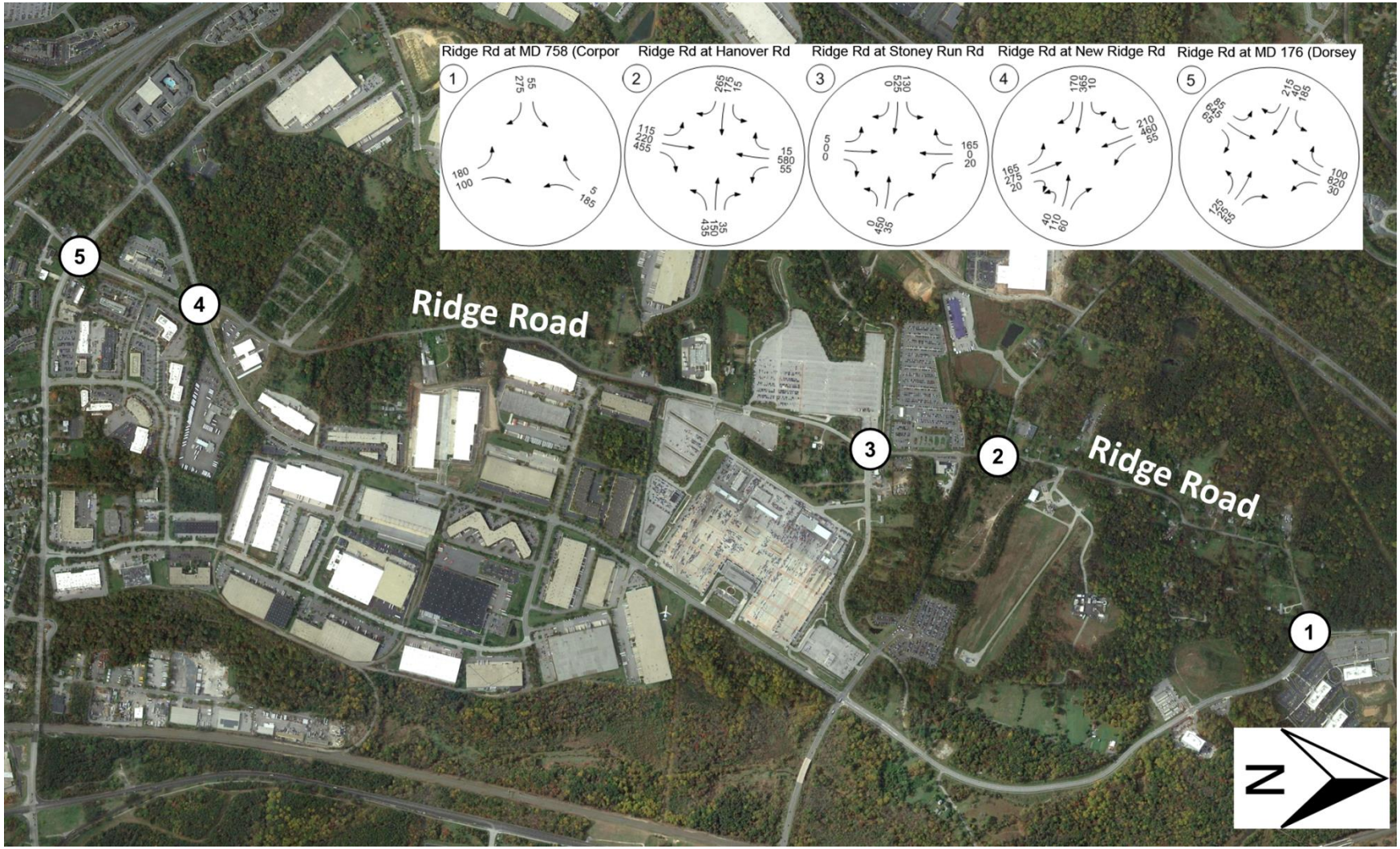


Figure 4: Future Year 2040 PM Peak Hour Intersection Volumes

3.3 Year 2040 No-Build Capacity Analysis

To conduct a traffic operations analysis, a validated Synchro model of the No-Build 2040 roadway network was developed and populated with forecasted future year 2040 volumes. An intersection capacity analysis was performed using CLV and HCM – with all existing signal timings maintained. Queuing along intersection approaches was also assessed. Table 4 summarizes the HCM and CLV capacity analysis results for the nine study intersections, with detailed CLV worksheets and Synchro HCM reports are in Appendix B and C, respectively.

The results of the HCM and CLV capacity analysis, indicate that only the intersection of Ridge Road at Hanover is expected to operate at an unacceptable LOS overall during the PM peak hour under the No-Build 2040 scenario. The following movements also fail at this intersection:

- Eastbound left
- Westbound through-right
- Northbound through-left

Additionally, the southbound *movement* of Ridge Road at Stoney Run Road is expected fail in the PM peak hour. All other intersections remain at acceptable levels of service.

Queuing was assessed with SimTraffic using the same methodologies discussed in Section 2.4. As shown in Table 4, extensive queuing was recorded in the northbound direction at Ridge Road and Hanover Road during the PM peak hour only. The 675-foot queue is because the northbound lane is a *shared* left-through lane and has a high demand for northbound vehicles to make a left turn towards the new Baltimore/Washington Parkway Interchange at Hanover Road. Additionally, the southbound Ridge Road approach to New Ridge Road has PM queues that could starve access to the right turn lane; it is recommended to increase right turn lane length from 175 feet to 300 feet. Queuing reports can be found in Appendix D.

The development of the build alternative is based primarily on the need to mitigate both the queuing and the intersections that are expected to have a failing LOS in year 2040.

Table 4: Year 2040 No-Build Intersection Capacity Analysis Results

#	Intersection	Movement	2040 No Build Conditions AM (PM)						2040 No Build Conditions AM (PM)
			Delay/Veh (sec)	Level of Service	Volume/ Capacity Ratio	Critical Lane Volume	Level of Service	Volume/ Capacity Ratio	95th Queues
1	Ridge Rd at Corporate Center Dr*	**Overall**	**3.7 (4.1)**	**A (A)**	**0.07 (0.11)**	**Roundabout CLV Analysis Not Applicable**			**- (-)**
		EB	3.8 (3.7)	A (A)	0.06 (0.05)				57 (46)
		NB	3.8 (4.1)	A (A)	0.07 (0.09)				55 (81)
		SB	3.6 (4.3)	A (A)	0.04 (0.11)				20 (42)
2	Ridge Rd at Hanover Rd**	**Overall**	**24.1 (59.1)**	**C (E)**	**0.75 (1.07)**	**1117 (1512)**	**B (E)**	**0.70 (0.95)**	**- (-)**
		EBL	24.4 (84.9)	C (F)	0.38 (0.88)				99 (203)
		EBT	30.4 (42.4)	C (D)	0.55 (0.35)				133 (198)
		EBR	27.3 (4.24)	C (D)	0.12 (0.31)				45 (174)
		WBL	24.3 (38.4)	C (D)	0.34 (0.23)				78 (170)
		WBTR	31.1 (80.7)	C (F)	0.58 (0.99)				179 (361)
		NBLTR	26.8 (89.6)	C (F)	0.85 (1.11)				242 (674)
		SBLTR	10.4 (10.0)	B (A)	0.48 (0.41)				208 (262)
3	Ridge Rd at Stoney Run Rd**	**Overall**	**18.4 (40.5)**	**- (-)**	**- (-)**	**795 (955)**	**A (A)**	**0.50 (0.60)**	**- (-)**
		EBL	8.9 (10.4)	A (B)	0.00 (0.01)				0 (22)
		EBTR	8.3 (9.8)	A (A)	0.01 (0.00)				24 (0)
		WBL	9.5 (10.1)	A (B)	0.05 (0.05)				36 (36)
		WBTR	9.6 (11.8)	A (B)	0.23 (0.33)				56 (75)
		NBLTR	12.4 (27.8)	B (D)	0.46 (0.81)				96 (199)
		SBLTR	24.4 (58.2)	C (F)	0.80 (1.00)				109 (190)
4	Ridge Rd at New Ridge Rd	**Overall**	**12.7 (15.2)**	**B (B)**	**0.39 (0.55)**	**624 (1010)**	**A (B)**	**0.39 (0.63)**	**- (-)**
		EBLTR	5.9 (9.7)	A (A)	0.32 (0.43)				136 (236)
		WBLTR	5.0 (8.9)	A (A)	0.18 (0.43)				88 (153)
		NBL	20.1 (20.9)	C (C)	0.05 (0.30)				14 (44)
		NBT	22.3 (19.4)	C (B)	0.40 (0.23)				86 (70)
		NBR	20.0 (18.2)	C (B)	0.04 (0.04)				13 (10)
		SBLT	24.6 (30.1)	C (C)	0.59 (0.78)				131 (243)
		SBR	20.7 (18.7)	C (B)	0.15 (0.12)				82 (167)
5	Ridge Rd at Dorsey Rd	**Overall**	**16.7 (19.4)**	**B (B)**	**0.66 (0.59)**	**957 (1051)**	**A (B)**	**0.60 (0.66)**	**- (-)**
		EBL	5.9 (9.1)	A (A)	0.21 (0.29)				100 (77)
		EBTR	15.4 (12.7)	B (B)	0.70 (0.4)				223 (145)
		WBL	9.7 (9.1)	A (A)	0.26 (0.08)				58 (37)
		WBTR	11.6 (15.8)	B (B)	0.34 (0.55)				115 (194)
		NBLT	31.0 (32.2)	C (D)	0.25 (0.53)				72 (144)
		NBR	29.3 (27.2)	C (C)	0.02 (0.04)				41 (45)
		SBL	39.5 (44.9)	D (C)	0.66 (0.76)				134 (167)
		SBT	29.6 (27.3)	C (C)	0.06 (0.05)				35 (44)
		SBR	29.7 (28.0)	C (C)	0.07 (0.15)				0 (53)

* Roundabout Intersection

4.0 YEAR 2040 FUTURE BUILD CONDITIONS

4.1 Development of Recommended Design

As discussed in the previous section, one study intersection – Ridge at Hanover – will require mitigation to achieve an acceptable LOS under future year 2040 traffic conditions. Additionally, the intersection of Ridge at Stoney Run will require improvements to prevent failing conditions along the southbound movement. This section of Ridge Road has a two-lane cross-section that is expected to adequately serve the corridor by the 2040 design year, with minor improvements to select intersections to correct failing LOS. The recommended design is for Ridge Road to remain as a two-lane roadway, with curbs added to add protection for vehicles and pedestrians.

In addition to the need to improve traffic, bicycle and pedestrian infrastructure will need to be upgraded to County standards. Pedestrian and bicycle infrastructure is currently limited throughout the Ridge Road corridor, despite its proximity to nearby trails. The projected mixed-use, commercial, and industrial growth along the corridor further emphasizes the need to upgrade pedestrian and bike facilities. Accordingly, the recommended design also provides continuous pedestrian and bike facilities along the entire corridor.

4.2 Preliminary Engineering for Preferred Alternative

Concept plans were developed for the Recommended Design in order to come up with cost estimates and better estimate necessary right-of-way acquisitions, utility relocations, and environmental impacts. Detailed concept plans of the Recommended Design are provided in Appendix E.

The concept plans show important features such as proposed resurfacing, pavement, sidewalk, and green space areas, pavement areas to be removed, property lines, guardrail, overhead electric lines, inlets, signal poles, pole-mounted control cabinets, fire hydrants, ground-mounted signs, light poles, utility poles, bus stops, and existing and proposed lane configurations/pavement markings.

4.2.1 Proposed Roadway Geometry and Typical Cross-Sections

The proposed roadway geometry for Ridge Road, from New Ridge Road to Corporate Center Drive, is to remain a two-lane cross-section with two 11-ft lanes in each direction. South of New Ridge Road to Dorsey Road, roadway geometry will remain unchanged from the existing conditions. Additional turn lanes were recommended at Hanover Road to mitigate failing level of service conditions[7]. Detailed description of all proposed roadway improvements and cross-sections ensue. As shown in the figure below, the typical cross-section constitutes:

- 32’ curb to curb road bed, with
  - 11’ travel lanes and 5’ bikes lanes
- 5’ sidewalk with 3’ buffer from the roadway – both sides of the road
- A drainage swale on both sides of the road.

[7] LOS D, per County standards

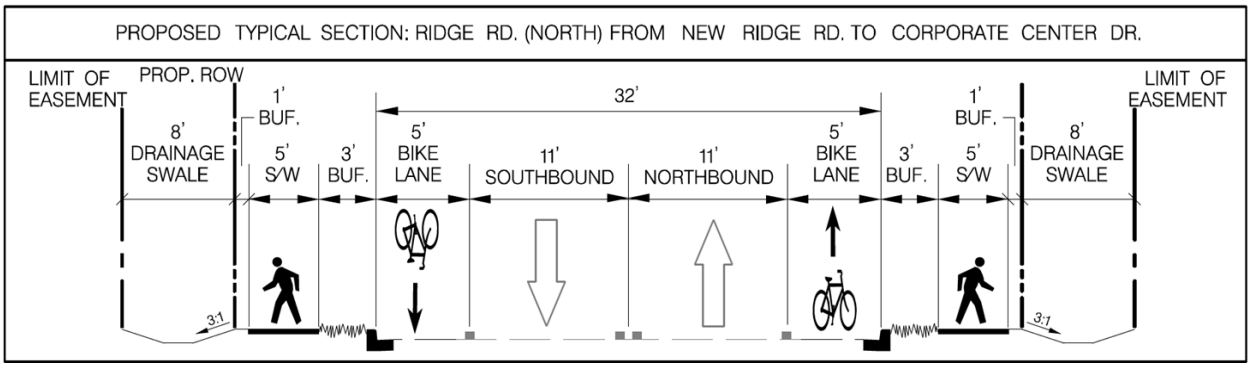


Figure 5: Proposed Cross-Section for Ridge Road

Additionally, the intersection of Hanover Road with Ridge Road has two proposed turn bays:

- One northbound left only
- One southbound right only

4.2.1.1 Additional Intersection-Related Improvements

As discussed previously, the recommended alternative developed for Ridge Road (between New Ridge Road and Corporate Center Drive) recommends maintaining the existing two-lane cross-section. Additional improvements include:

1. Improving pedestrian crossings at multiple locations. The recommend design also proposes crosswalks to be striped across Ridge Road at:
    - New Ridge Road
    - Stoney Run Road
    - Hanover Road
2. A pedestrian signal is proposed for crossing all existing and proposed crosswalks at
    - New Ridge
    - Hanover Road
3. At the intersection Ridge Road at Stoney Run Road, the recommended design proposes replacing the four-way stop control with two-way stop control on the minor street approaches.
4. At the intersection of Ridge Road at Hanover Road, the recommended design proposes an additional 200-ft northbound left turn lane and 200-ft southbound right turn lane.
5. At the intersection of Ridge Road and New Ridge Road, the recommended design proposes lengthening the right turn bay from 175 feet in the existing condition to 300’ in the proposed condition.

Based on the recommended cross-sections and intersection-specific improvements, the expected lane configuration is shown in Figure 6.

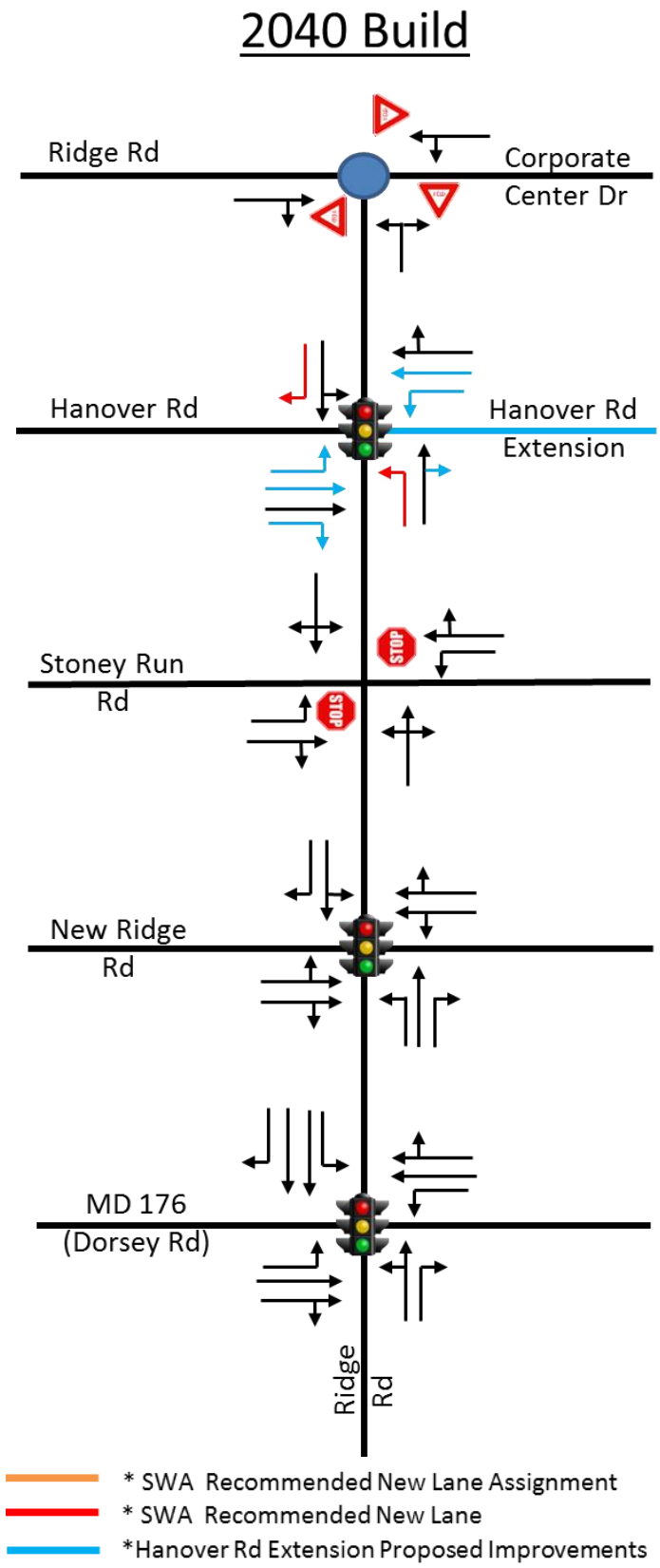


Figure 6: Future Year 2040 Recommended Intersection Lane Configurations

4.2.2 Year 2040 Capacity Analysis – Recommended Design

A capacity analysis was performed for the Recommended lane configuration shown in Figure 6. All of the improvements shown were effective at bringing traffic conditions to an acceptable level for all of the study intersections. The results of the capacity analysis performed for this Build alternative are summarized in Table 5 (only the improved intersections are shown). Detailed CLV worksheets and Synchro HCM reports are in Appendix B and C, respectively.

Additionally, the recommended intersection improvements relieved queuing along northbound Ridge Road at Hanover. Queuing summary tables can be found in Appendix D.

Table 5: Year 2040 Build Alternative Intersection Capacity Analysis (Improvements only)

#	Intersection	Movement	2040 Build Conditions AM (PM)							
			Delay/Veh (sec)	Level of Service	Volume/ Capacity Ratio	Critical Lane Volume	Level of Service	Volume/ Capacity Ratio	95th Queues (ft)	
2	Ridge Rd at Hanover	**Overall**	**23.8 (29.2)**	**C (C)**	**0.56 (0.73)**	**917 (1069)**	**A (B)**	**0.57 (0.67)**	-	(-)
		EBL	22.0 (22.2)	C (C)	0.33 (0.45)				59	(94)
		EBT	29.0 (24.9)	C (C)	0.54 (0.22)				143	(110)
		EBR	26.0 (26.0)	C (C)	0.12 (0.31)				53	(135)
		WBL	22.3 (26.2)	C (C)	0.31 (0.17)				75	(248)
		WBTR	30.0 (37.6)	C (D)	0.58 (0.74)				147	(216)
		NBL	11.3 (21.3)	B (C)	0.51 (0.73)				173	(287)
		NBTR	8.5 (13.3)	A (B)	0.13 (0.21)				101	(247)
		SBLT	29.8 (43.6)	C (D)	0.65 (0.67)				200	(200)
		SBR	23.1 (36.9)	C (D)	0.14 (0.37)				109	(135)
3	Ridge Rd at Stoney Run Rd**	**Overall**	**3.8 (4.4)**	**- (-)**	**- (-)**	**795 (955)**	**A (A)**	**0.50 (0.60)**	-	(-)
		EBL	0.0 (79.0)	A (F)	0.00 (0.01)				0	(0)
		EBTR	10.6 (0.0)	B (A)	0.01 (0.00)				22	(20)
		WBL	27.7 (47.4)	D (E)	0.15 (0.05)				48	(43)
		WBTR	10.9 (14.3)	B (B)	0.18 (0.33)				55	(79)
		NBLTR	0.2 (0.0)	A (A)	0.00 (0.81)				21	(2)
		SBLTR	3.0 (3.3)	A (A)	0.11 (1.00)				111	(173)

** Stop Controlled Intersection

4.2.3 Pedestrian and Bicycle Improvements

Expansion of the existing pedestrian and bicycle infrastructure is recommended as part of the Recommended Design.

From New Ridge Road to Corporate Center Drive, the Recommended Design will provide continuous bike lanes and sidewalks along both the east and west sides of Ridge Road. Details of the pedestrian/bicycle infrastructure for the corridor are provided below (refer to the cross-section figures in the previous sub-section):

- 5' dedicated bike lanes are provided on each side of Ridge Road
- 5' sidewalk with a 3' grass buffer is provided on each side of Ridge Road

4.3 Stormwater

For Ridge Road from New Ridge Road north to Corporate Center drive (2.25 miles), stormwater management requirements are expected to be met via the dual grass swales shown in the concept plans (i.e. the blue shading). Grass swales are grass-lined channels that convey stormwater runoff, provide water quality treatment, and decrease and slow flow. They help

remove pollutants through vegetative filtering, sedimentation, biological uptake, and infiltration into the underlying soil.

4.4 Environmental

There are no known environmental (e.g. wetlands, protected forests, etc.) areas disturbed by the Recommended Design.

4.5 Right-of-Way Acquisition

Roadway improvements along the Ridge Road corridor include the addition of sidewalk and bicycle facilities, to improve pedestrian and bicycle safety and connectivity, as well as the addition of turning lanes to meet the Anne Arundel County guidelines of LOS D or better at all study intersections. These roadway improvements will increase the footprint of the roadway and require the acquisition of right-of-way and easements along sections of the corridor.

The total additional right-of-way and easements required to construct the preferred roadway design is 5.5 acres.

4.6 Cost Estimate

Construction cost estimates were developed for the Recommended Design using SHA's Major Quantities Estimates methodology. Major Quantities Estimates are used to estimate construction costs during the planning stage and early in the preliminary engineering stage. The idea is to estimate as accurately as possible those categories that can be estimated in the very early stages such as Grading, Paving, Structures and Shoulders items and compute the remaining categories as percentages of those categories. A total of ten categories were used for estimates.

The estimated construction cost along the corridor is $8 million to bring the existing roadway up to Anne Arundel County standards, which includes the installation of curb and gutter, sidewalks, widening for bike lanes, and stormwater management. Maintenance of Traffic (MOT) through construction phasing was estimated at a rate of 5% of total construction costs for a total of $325,000. Right of Way acquisition was based on $5/SF for residential, $10/SF for industrial, and $20/SF for commercial lane uses for a total of $835,000. Easement costs were based on unit prices ½ that of right-of-way for a total of $630,000. A detailed cost estimate break down is provided in Appendix F.

The cost estimate provided for the Recommended Design does not include relocation of underground utility costs, however, a generous contingency budget was assumed in the final construction cost estimate to account for known and unknown buried utilities.

5.0 SUMMARY AND RECOMMENDATIONS

The findings and recommendations for the Ridge Road transportation facilities planning study are as follows:

- By Year 2040, traffic volumes are expected to double along the corridor to approximate 5,000 ADWT.
- Expected growth along the length of the corridor will result in the following study intersections operating at a LOS E or worse overall during weekday AM or weekday PM peak hour under the No-Build 2040 scenario:
  - Ridge Road at Hanover Road
  - Additionally, the southbound left-through-right lane at Stoney Run Road will exhibit failing conditions during the PM peak hour, though the intersection as a whole will not.
- A preferred design concept was developed that includes the following:
  3. Due to low projected year 2040 ADWT and peak hour volumes, no changes to the typical roadway lane configuration are proposed along the corridor with the exception of the Hanover Road intersection. The roadway is recommended to remain two lanes.
  4. Minor intersection improvements include:
     a. Adding dedicated northbound left- and southbound right-turn lanes at Hanover Road to accommodate increases in vehicle trips due to the proposed Hanover Road Extension and interchange at MD 295
     b. Changing the stop control at Stoney Run Road from an existing four-way stop to two-way stop control on the east-west legs.
     c. Lengthening the southbound right turn bay along Ridge Road at the intersection of New Ridge Road from 175 feet to 300 feet.
- To improve pedestrian connectivity in the area, a new continuous sidewalk is proposed on both the east and west sides of Ridge Road from Dorsey Road to Corporate Drive.
- Bicycle improvements recommended for the 2040 design year include continuous on-road bike lanes along the east and west sides of Ridge Road between New Ridge Road and Corporate Center Drive.
- Stormwater improvements include 8-feet wide dual swales on both the east and west sides of the roadway from New Ridge Road to Corporate Center Drive.
- During Final Design, vertical and horizontal roadway curvature should be reviewed to insure that it meets County standards for the current design speed of the road.
- The total amount of new right-of-way and easement acquisition required under the recommended design for year 2040 is about 5.5 acres.
- The estimated construction cost for the recommended design is $8 million.

Appendix A:

Ridge Road Travel Demand Forecasting & Validation Memo; Future AWDT

Sabra, Wang & Associates, Inc.
Engineers • Planners • Analysts

MEMORANDUM

To:	Project 15.52 and 15.53 files
From:	Joe Giancarlo, James Bunch. SWAI
Subject:	Anne Arundel County Ridge Road North and South Travel Demand Forecasting Process and Results
Date:	August 15, 2016

This memorandum documents the travel demand forecasting and traffic analysis carried out for the Anne Arundel Transportation Facility Planning – MD 713 Corridor/Ridge Road North and South studies. The purpose of the study is to identify the necessary transportation improvements (roadway, intersections, pedestrian, bicycle etc.) and right of way easements to safely accommodate future travel demand along Ridge Road MD 713 from Corporate Center Drive and New Ridge Road (Northern Section) and Dorsey Road (MD 176) to the Access Control Point (ACP) of Fort George G. Meade (FGGM) at Rockenbach Road (MD 713) south of Annapolis Road (MD 175) (Southern Section). Presently, Ridge Road MD 713 within the confines of the study is classified as a 2 lane minor arterial.

1 Travel Demand Forecasting Process Overview

The analysis uses as a foundation the currently adopted Baltimore Metropolitan Council's Travel 4.4, which incorporates the adopted 16-19 Transportation Improvement Program and Maximize 2040 Long Range Plan Round 8a Cooperative Land Use Forecasts (2010, 2017, 2025, 2035, and 2040 horizon years) received from BMC in September 2015. This section provides a brief summary of the overall BMC Travel 4.4 model, and then describes the subarea analysis process used for the traffic forecasts within the corridor

1.1 Regional BMC Travel Model 4.4

The BMC Travel Model was developed by the Baltimore Metropolitan Council for the Baltimore Regional Transportation Board. Using a "four step", trip-based model it simulates transportation demand, travel patterns and trips (vehicle and transit) on the highway and transit system throughout the modeled region. The BMC 4.4 model flow and steps are shown in Figure 1: BMC Model Flow Chart in simplified form. The network is skimmed initially to get AM peak travel times before the first round of trips are generated and distributed between the TAZs. The mode choice process then determines which modes are used for each trip; based on trip type, income, and disutility functions for each mode. These trips are assigned to the network, followed by another skim. The new skims are used to redistribute and reassign trips twice before the model is run with all time periods. The iterations ensure that the times and costs used as inputs for trip distribution and mode split are consistent with the output in the final run. The regional travel demand model also runs sub-models for determining area type, accessibility, terminal and intrazonal times, parking costs, and air passengers. These are further documented in the Baltimore Region Travel Demand Model 4.0 - 4.4 version model guide (Baltimore Regional Travel Demand Model 4.0 Model Guide, BMC, June 2011), and subsequent model update memorandum and were not modified as part of the Ridge Road Study.

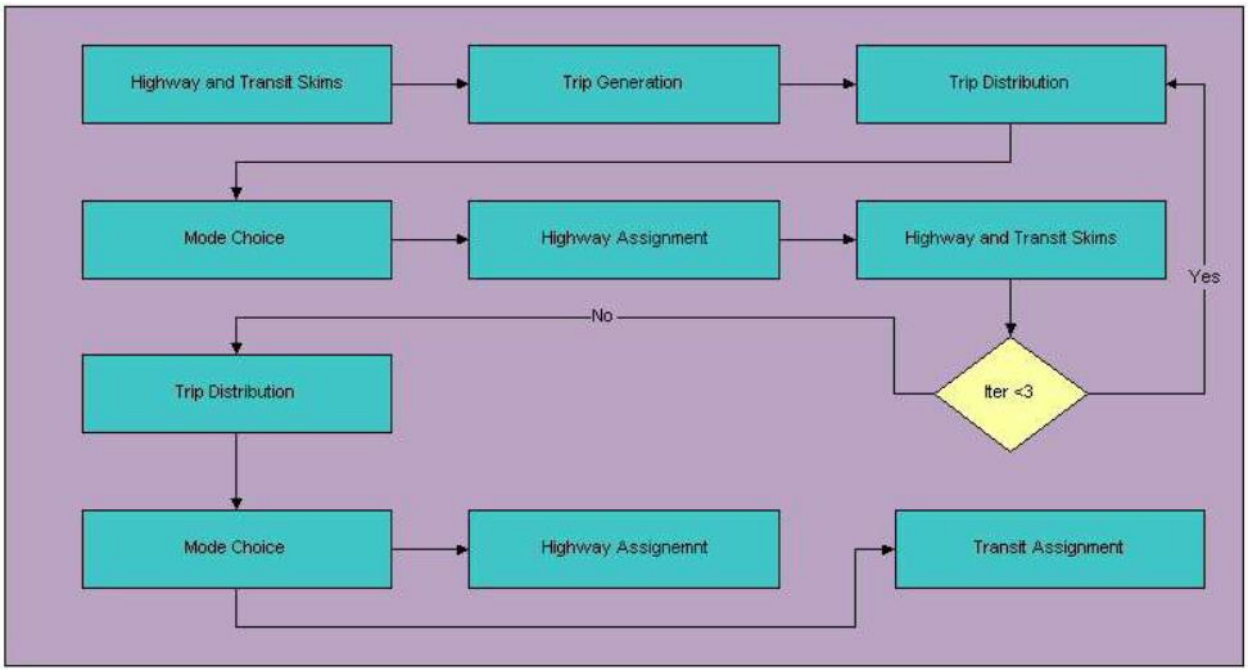


Figure 1: BMC Model Flow Chart

The BMC Regional model area includes Baltimore City and the counties of Anne Arundel, Baltimore, Carroll, Harford, Howard, and in less detail: Prince George's, Montgomery, Frederick, and the District of Columbia. Counties are further subdivided into 1767 internal travel analysis zones (TAZ). In addition there are 42 external stations that account for trips crossing into and from the region. Each TAZ has demographic and travel data that represents the productions and attractions for that area, this is manifested in the centroid of each zone. The highway network is made up of links which are connected by intersection nodes. Links are classified into categories based on their functional type, which determines input speeds, and road type, which determines its capacity. The area covered by the regional model with the Ridge Road subarea highlighted is shown in Figure 2

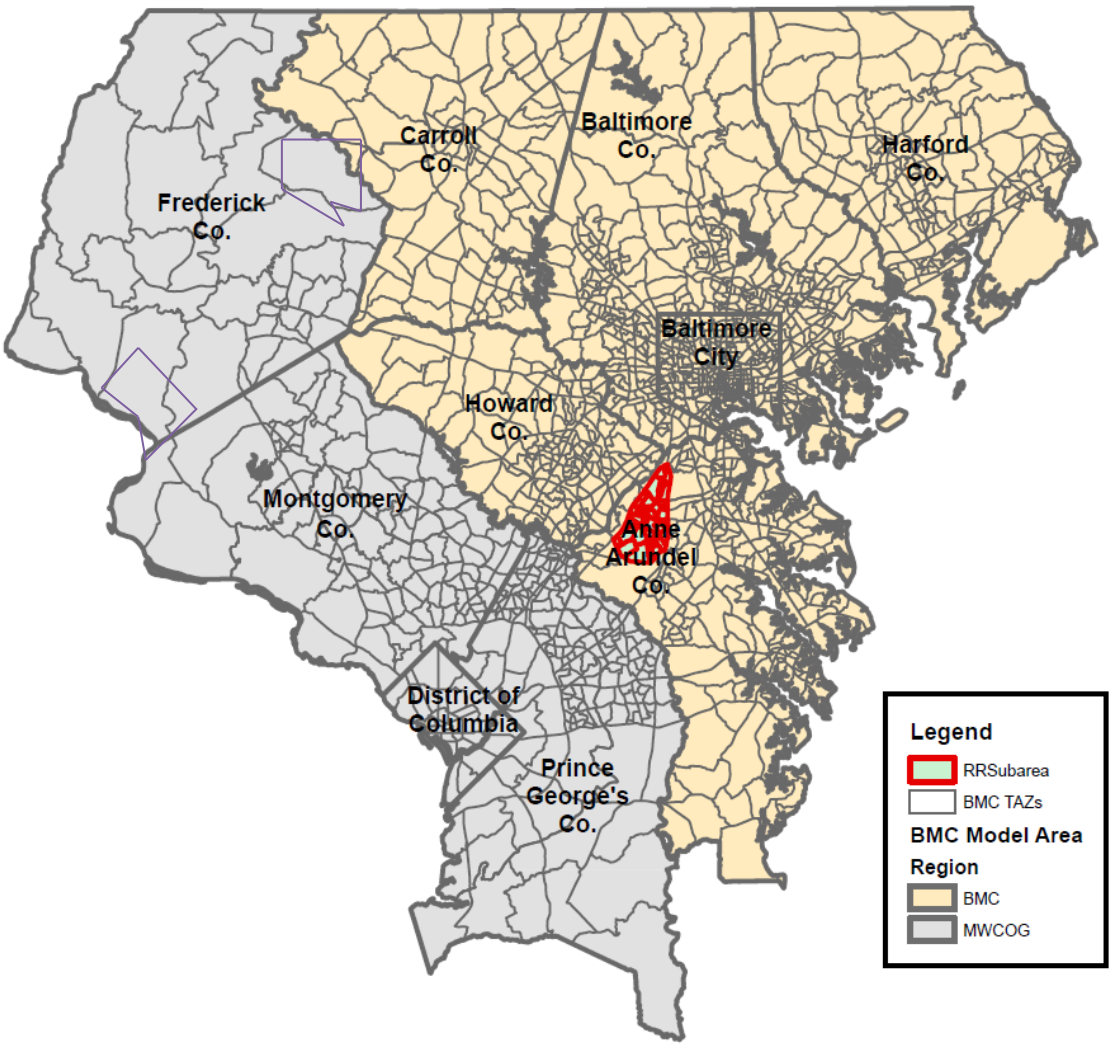


Figure 2: Ridge Road Study Area Location in Baltimore Regional Travel Demand Model Network

1.2 Subarea Analysis Process

The BMC Travel Model 4.4 TAZs and network detail were created in order to forecast travel on and analyze the regionally significant travel patterns and facilities within the adopted Travel Improvement Programs and Long Range Transportation Plan. Smaller TAZs and more network detail are needed to capture the impacts of new developments and specific traffic patterns/flows for project development within a specific corridor/subarea. This additional detail can be incorporated into the regional model land use data and highway/transit networks and new forecasts carried out using the full model process with mode choice and feedback loops, or when a subarea with no regionally significant new facilities or developments is being analyzed a subarea analysis/assignment process may be warranted. When there When no regionally significant developments or facilities are part of the study simply adding more detail on local and minor arterials within a subarea should not create significant shifts in the regional travel patterns (trip generation, trip distribution, mode split, and assignment in areas outside the study) or assignments in parts of the region far from the area in question. When an initial test was carried out for this study it seemed that the full BMC model was forecasting changes in trips and volumes from/to

areas not close to the Ridge Road Study area (e.g. Frederick County to Baltimore and volumes along I-70 and I-270). Consequently, a subarea analysis process was used for the Ridge Road North and South Corridors, which includes:

- Additional TAZ and network detail within the study subarea
- Post mode choice disaggregation of vehicle trips to the new TAZs
- Post mode choice traffic assignment using the subarea detailed network

This insures that the underlying regional trip generation, trip distribution, and mode split for the sub area study is the same as that found in the BMC regional model forecasts. The forecasts from the post mode choice traffic assignment are then used to develop the turning movements and other inputs to the SYNCHRO operational simulations using post-processing methods from the NCHRP Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design (NCHRP, 2015).

This sub area analysis process is shown in Figure 3. In this diagram the left side shows the BMC 4.4 networks are unchanged. The land use for BMC TAZs was updated to include the growth projections for the study area. The full model was run using the BMC TAZs and network, producing post mode choice trip tables at the BMC TAZ level. The right side of the diagram shows the sub area model, which used the split TAZs for the ridge road study area. Additional network detail was also added to capture local traffic options and connect the new TAZs to the network (centroid connectors). The updated BMC land use data was split between the study area TAZs. The BMC post mode choice trip tables were split using variables that represent the productions and attractions in each new zone (using the variables ROWPCT and COLPCT). The productions split was based on the percentage of households in each subzone and the attractions were based on the percentage of total employment. The sub area traffic assignment uses the network detail, land use attributes, and trip tables from the split TAZs, resulting in an output of average weekday volumes by direction.

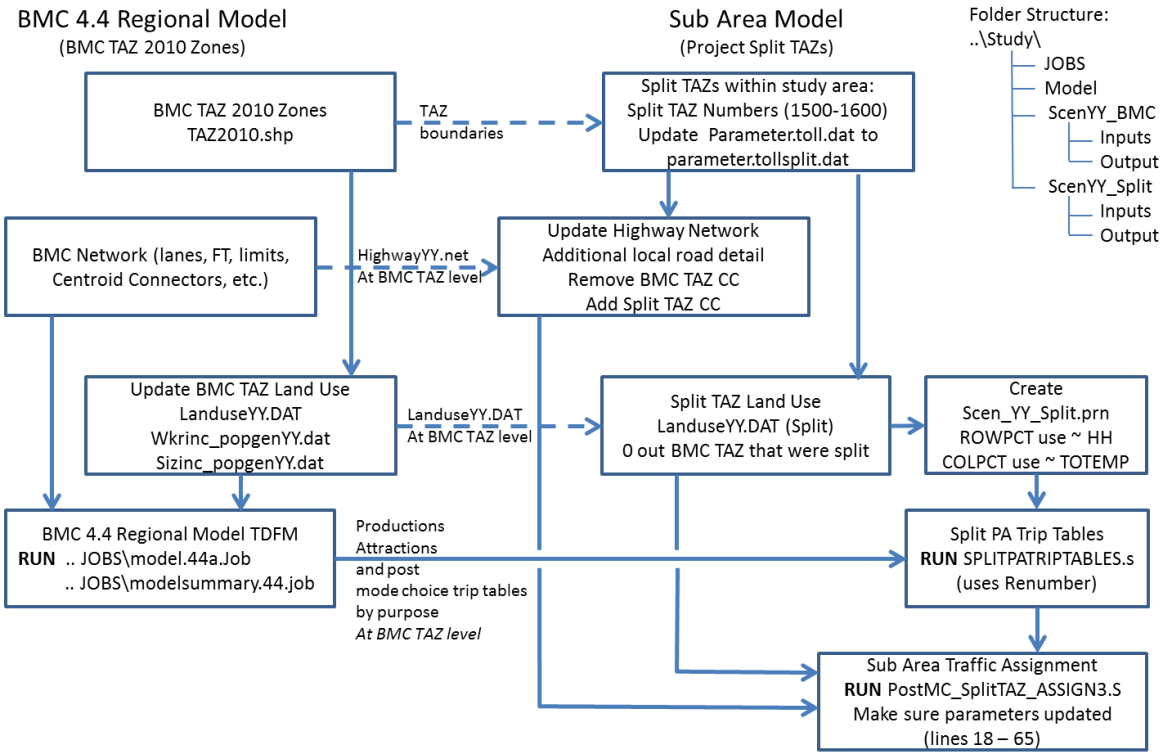


Figure 3 Ridge Road Sub Area Travel Forecasting Process

The details of the changes made and the results are further described in the remainder of this memorandum.

2 Base Year (2016/2017) Model Subarea and Validation

For this study the BMC 4.4 regional model was used as a baseline, with subarea focusing used to represent the study area along Ridge Road. The model study area extends along MD-32 (Patuxent Freeway) in the south from MD-295 (Baltimore-Washington Parkway) to the Amtrak rail line. The Eastern border follows the Amtrak line to the MD-295 and I-95 interchange and the western border runs along MD-295. This encompasses the Arundel Mills Mall, Fort Meade, as well as bordering Baltimore/Washington International airport. This area is shown in Figure 5 .

The Ridge Road 2017 Subarea Validation Process is shown in Figure 4. First, the 2017 BMC 4.4 model (using BMC TAZs) was run in order to provide the baseline productions and attractions along with the post mode choice trip tables by purpose. For the subarea model the BMC TAZs were then split in order to create the required additional detail. As seen in Figure 5 twenty three new zones were created from eight BMC zones. BMC centroids were replaced with new centroids for each subarea zone. The centroid connectors were placed so that the same nodes were connected as before, with additional nodes added by splitting links where it better represented the actual road network.

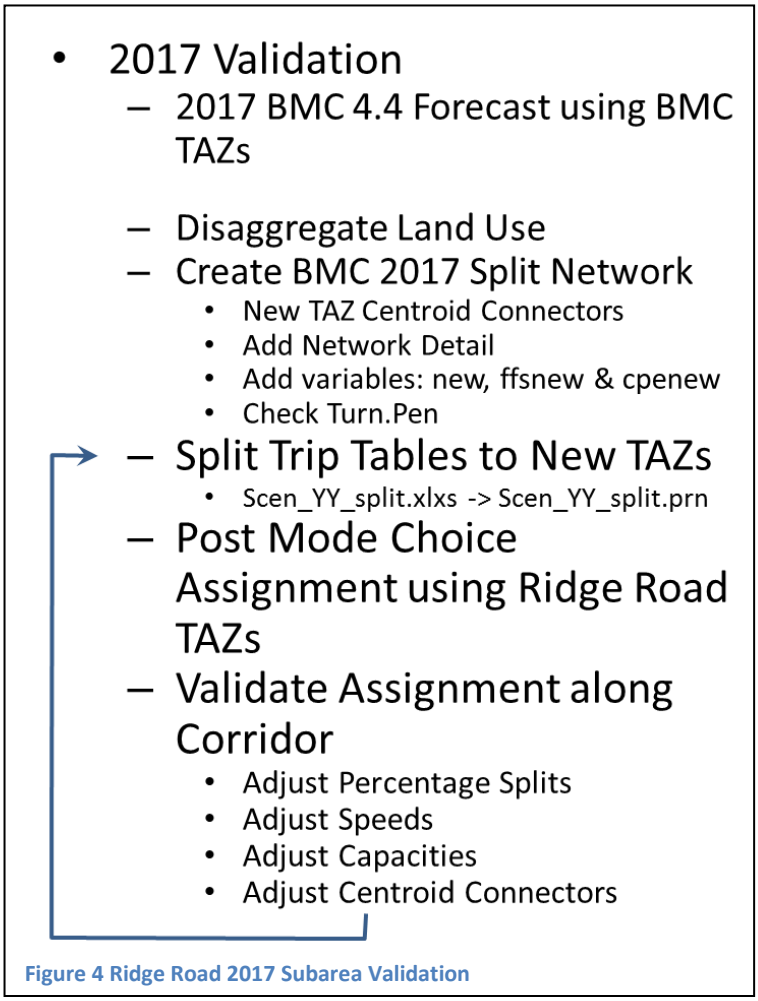
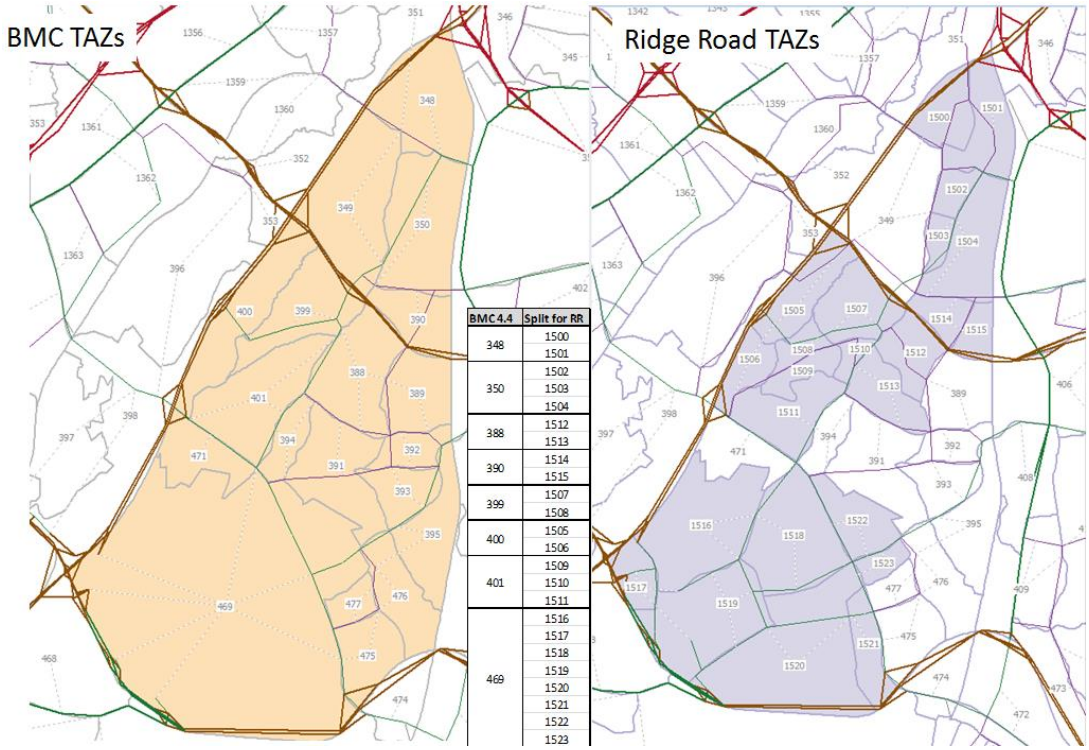


Figure 4 Ridge Road 2017 Subarea Validation



BMC 4.4	Split for RR
348	1500
	1501
350	1502
	1503
	1504
388	1512
	1513
390	1514
	1515
399	1507
	1508
400	1505
	1506
401	1509
	1510
	1511
469	1516
	1517
	1518
	1519
	1520
	1521
	1522
	1523

Figure 5 Ridge Road Study Area TAZ Splits

The TAZs from the BMC model were split into smaller zones for improved resolution of the study area. The Ridge Road subarea TAZ borders were based on the Howard County BRT study zones and the Anne Arundel County SAM II model zones as well as the boundaries of existing and proposed developments in the area. The new zones did not extend beyond the border of the original BMC zone, so that the BMC land use data could be split amongst them as seen in Table 1 Disaggregation of BMC Land Use to Subarea Zones. Land use data from the Howard County and SAM II models was compared to determine the ratio of the BMC TAZs' households, population, and employment to distribute to each new zone. Where the boundaries of the Howard County and Sam II models and the new zones did not overlap, parcel data and Google Earth observations were used to estimate the ratio of businesses and households in each zone. This land use data was then used to split the post mode choice trips from the BMC model run coming to and from the study area.

Network detail was then added to better capture local travel paths to/from the developments and split zones within the study area. Where local streets served primarily to provide access/egress to the new TAZs, they were represented by centroid connectors (e.g. TAZ 1505 and Dorchester Rd). The network detail added to the model includes:

- (Old) Ridge Road – MD-100 to Furnace Ave
- Dorsey Road – West of Ridge Road to Harmans Rd
- Wright Road – MD-100 to Race Rd
- Race Road – MD-175 to MD-100 and Hanover Rd to Furnace Rd
- Clark Road – MD-175 to Ridge Rd
- Ridge Chapel – Ridge Rd to Harmans Rd
- Coca Cola Drive – MD -100 to Hanover Rd
- Loudon Avenue – US-1 to Hanover Rd.
- River Road

- Fort Meade Internal Roads and Gates

New links were assigned attributes that correspond to the zone they are in.

Table 1 Disaggregation of BMC Land Use to Subarea Zones

BMC TAZ	RR TAZ	HH	Pop.	Tot. Empl
348	1500	75	175	235
348	1501	6	14	1218
350	1502	7	17	989
350	1503	5	14	460
350	1504	5	14	3664
400	1505	155	343	219
400	1506	1037	2303	65
399	1507	1	3	7368
399	1508	219	720	0
401	1509	292	563	0
401	1510	240	462	0
401	1511	296	572	50
388	1512	356	1016	72
388	1513	589	1677	115
401	1514	468	1504	191
409	1515	43	122	484
469	1516	1116	3869	0
469	1517	0	0	8504
469	1518	874	3359	4075
469	1519	0	0	16570
469	1520	364	2443	14168
469	1521	0	0	9828
469	1522	0	0	3916
469	1523	0	0	3370

A post mode choice traffic assignment using the new ridge road TAZs, network, and split trips to and from the study area was then carried out. Further improvements were made to the study area to better represent the observed traffic flow. SWA found that simply using the regional model look up tables for free flow speed based upon area type and functional class, and for capacity based upon area type and road type tended to overestimate the free flow speeds in the area (40 plus miles per hour on all local roads). Therefore, a variable to override the free flow speed calculated by the model (normally based on functional type) was assigned to new links in the corridor as well as others where the assigned volume was too high. The new variable accounts for the increased friction of the rural, two lane roads in the study area that was previously causing over assignment. In addition, turn penalties were used to control flow into Fort Meade, creating gates that eliminate pass through trips. Turn penalties were also used in the north section to account for perceived barriers in crossing MD 295 and correct the assigned volumes as compared to counts. These improvements are seen in Figure 6 Ridge Road 2017 Network Detail below.

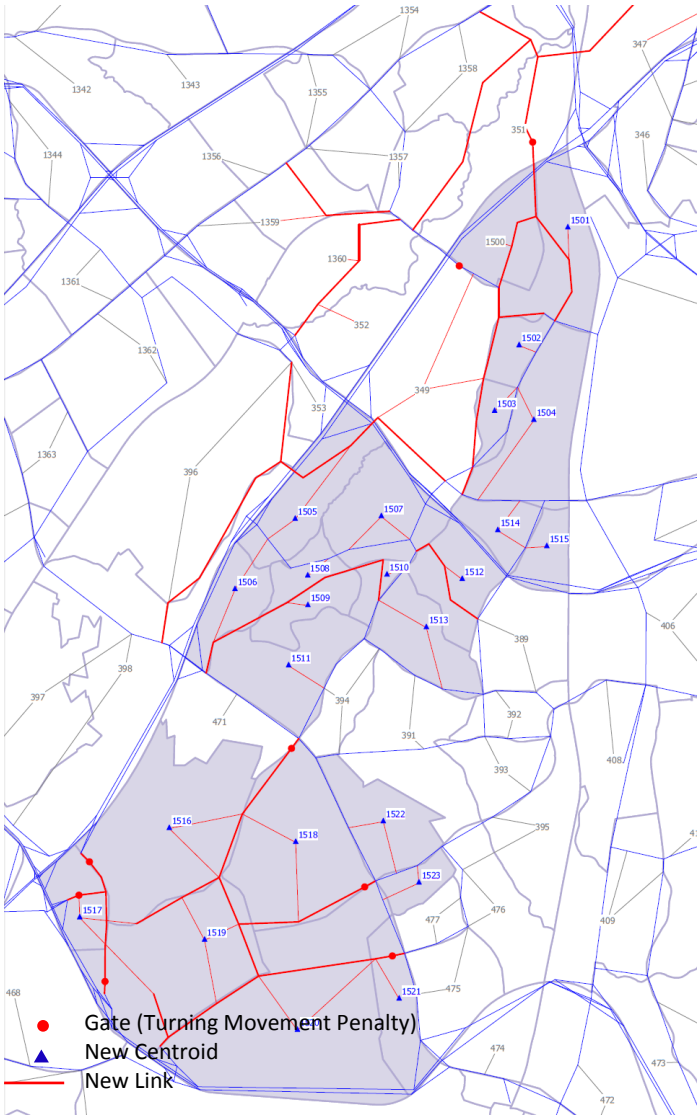


Figure 6 Ridge Road 2017 Network Detail

In order to validate the subarea network improvements and TAZ changes, the assigned volumes from the 2017 base year subarea model were compared to a variety of count data. The BMC 2017 model contained 2010 average weekday daily trips from SHA count stations. The 2010 AWDT were increased to 2017 values using a growth rate of 0.5%. Where 2010 data was not available, recent counts were taken from SHA's I-TMS and grown at 0.5% to 2017. The comparison with the AWDT, the BMC 2017, and the Ridge Road 2017 is shown in Table 3. The increased network detail in the subarea model is evident by the assigned volumes more closely matching the 2017 AWDT, particularly at Hanover Road and the northernmost sections of Ridge Road. Similarly, the MD-175 segment was more accurately represented, especially along southern Ridge Road.

To insure that the regional model was not significantly affected by changes in the subarea, the volume assignment along screenlines was compared for each model. The regional screenlines surrounding the study area and the differences in volumes are shown in Table 2 . Screenline 42, which cuts along the east side of I-97 from I-695 to MD-32, is reduced just over 1 %. All other screenlines are changed by less than 1 %. The validated volumes along with count data are depicted in Figure 7 Ridge Road Study 2017 Model assignment and counts. Overall, this indicates that the changes made in the subarea model did

not cause commuters' paths to change on the regional scale; which is appropriate because of the class of Ridge Road.

Table 2 Regional Screenline Checks

Screenline #	Name	24 Hour Volumes		% Diff
		BMC	SubArea	
14	Beltway Screenline (South)	390672	391128	0.1%
15	Beltway Screenline (Southwest)	565448	567064	0.3%
19	South Cordon Line	295459	295879	0.1%
20	Southwest Cordon (MD 32) Line	711259	712506	0.2%
42	West of MD3/I-97 Anne Arundel County	290263	286471	-1.3%
43	Howard/Anne Arundel County Line	450397	454503	0.9%

Table 3 Selected Segment Validation

				Percent Difference	
Segments	2017 AWDT	BMC 2017	Ridge Road 2017	BMC - AWDT	Ridge Rd - AWDT
Ridge Road at MD 295	2545	103	2771	-96%	9%
Hanover Rd - West of MD 295	2125	13713	2579	545%	21%
New Ridge Road North of Dorsey	13585	22000	14182	62%	4%
New Ridge Road North of MD 100	40125	44728	40368	11%	1%
Ridge Road North of MD 175	18000	20857	20290	16%	13%
MD 175 East of MD 295	32575	32817	32681	1%	0%
MD 175 East of Disney Road	24375	11652	24859	-52%	2%
Disney Road N of MD 175	7600	10407	8159	37%	7%

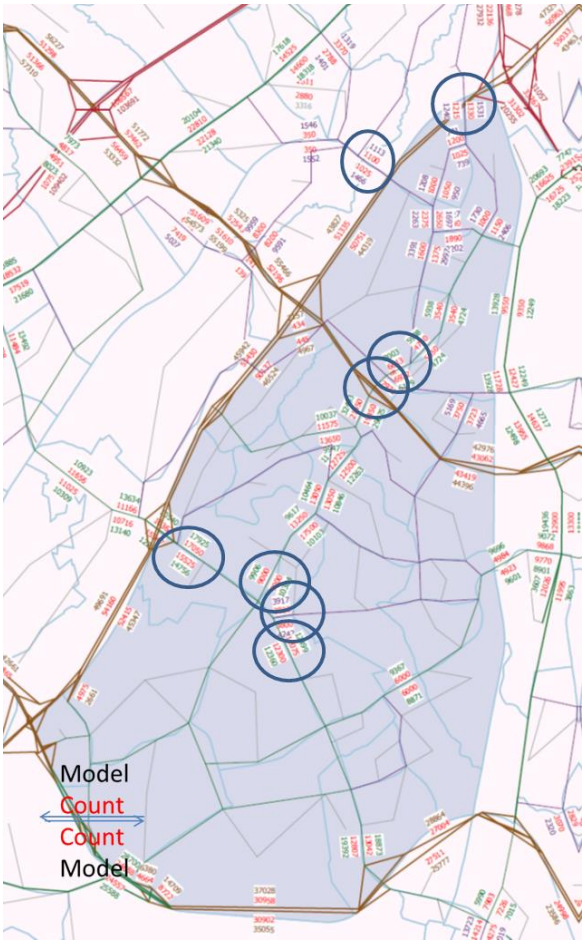


Figure 7 Ridge Road Study 2017 Model assignment and counts

3 Future Year (2040) Land Use and Networks

3.1 2017 to 2040 Land Use

Land use forecasts for the BMC 4.4 model were updated to create the sub area land use matrix. The future year subarea land use changes were the result of comparing the growth accounted for in the BMC 4.4 2040 model and the change in households and employment expected from proposed developments. All proposed developments were assumed to be completed by 2040. The differences in households, population, and employment between the two models, account for cases where not all of the development growth was accounted for in BMC 4.4 Round 8a Land Use (Table 4 Land Use Changes between BMC and Ridge Road Models for 2040).

Table 4 Land Use Changes between BMC and Ridge Road Models for 2040

		BMC 2017			BMC 2040			Ridge Road Development			Change from BMC		
BMCTAZ	RRTAZ	HH	POP	EMPL	HH	POP	EMPL	HH	POP	EMPL	HH	POP	EMPL
389	389	917	2578	69	1057	2764	72	1057	2764	72	0	0	0
391	391	996	2817	142	1184	3018	144	1327	3383	144	143	365	0
392	392	749	2149	14	770	2302	14	770	2302	14	0	0	0
393	393	1172	3335	143	1322	3575	148	1322	3575	148	0	0	0
394	394	640	1905	241	642	2042	248	642	2042	248	0	0	0
395	395	1243	3670	17	1463	3932	17	1463	3932	17	0	0	0
471	471	459	1163	367	1935	4567	1011	1998	4716	1011	63	149	0
475	475	2063	4815	560	2424	5160	759	2424	5160	759	0	0	0
476	476	1313	4076	143	1561	4368	193	1561	4368	193	0	0	0
477	477	565	1666	150	565	1786	204	565	1786	204	0	0	0
348	1500	75	175	235	42	100	91	252	577	850	210	477	759
348	1501	6	14	1218	39	90	1362	39	90	2204	0	0	842
350	1502	7	17	989	6	18	773	6	18	773	0	0	0
350	1503	5	14	460	3	7	1236	3	7	1236	0	0	0
350	1504	5	14	3664	8	23	4944	8	23	4944	0	0	0
400	1505	155	343	219	1235	2467	259	1330	2658	926	95	191	667
400	1506	1037	2303	65	184	368	159	282	563	818	98	195	659
399	1507	1	3	7368	22	78	10960	22	78	10960	0	0	0
399	1508	219	720	0	198	698	1218	198	698	1218	0	0	0
401	1509	292	563	0	345	387	21	345	387	22	0	0	1
401	1510	240	462	0	387	424	17	387	424	18	0	0	1
401	1511	296	572	50	792	901	22	1181	1327	1217	389	426	1195
388	1512	356	1016	72	414	1087	74	414	1087	74	0	0	0
388	1513	589	1677	115	685	1798	122	685	1798	122	0	0	0
401	1514	468	1504	191	504	1594	349	504	1594	349	0	0	0
409	1515	43	122	484	47	148	744	47	148	744	0	0	0
469	1516	1116	3869	0	1116	3869	0	1116	3869	0	0	0	0
469	1517	0	0	8504	0	0	8504	0	0	8504	0	0	0
469	1518	874	3359	4075	874	3359	4075	874	3359	4075	0	0	0
469	1519	0	0	16570	0	0	16570	0	0	16570	0	0	0
469	1520	364	2443	14168	364	2443	14168	364	2443	14168	0	0	0
469	1521	0	0	9828	0	0	9828	0	0	9828	0	0	0
469	1522	0	0	3916	0	0	3916	0	0	3916	0	0	0
469	1523	0	0	3370	0	0	3370	0	0	3370	0	0	0

Developments planned in the study area consist of commercial, retail, and housing, many in mixed use complexes, seen in Figure 8 Developments in the Ridge Road Study Area, with the number of jobs and dwelling units in each listed in

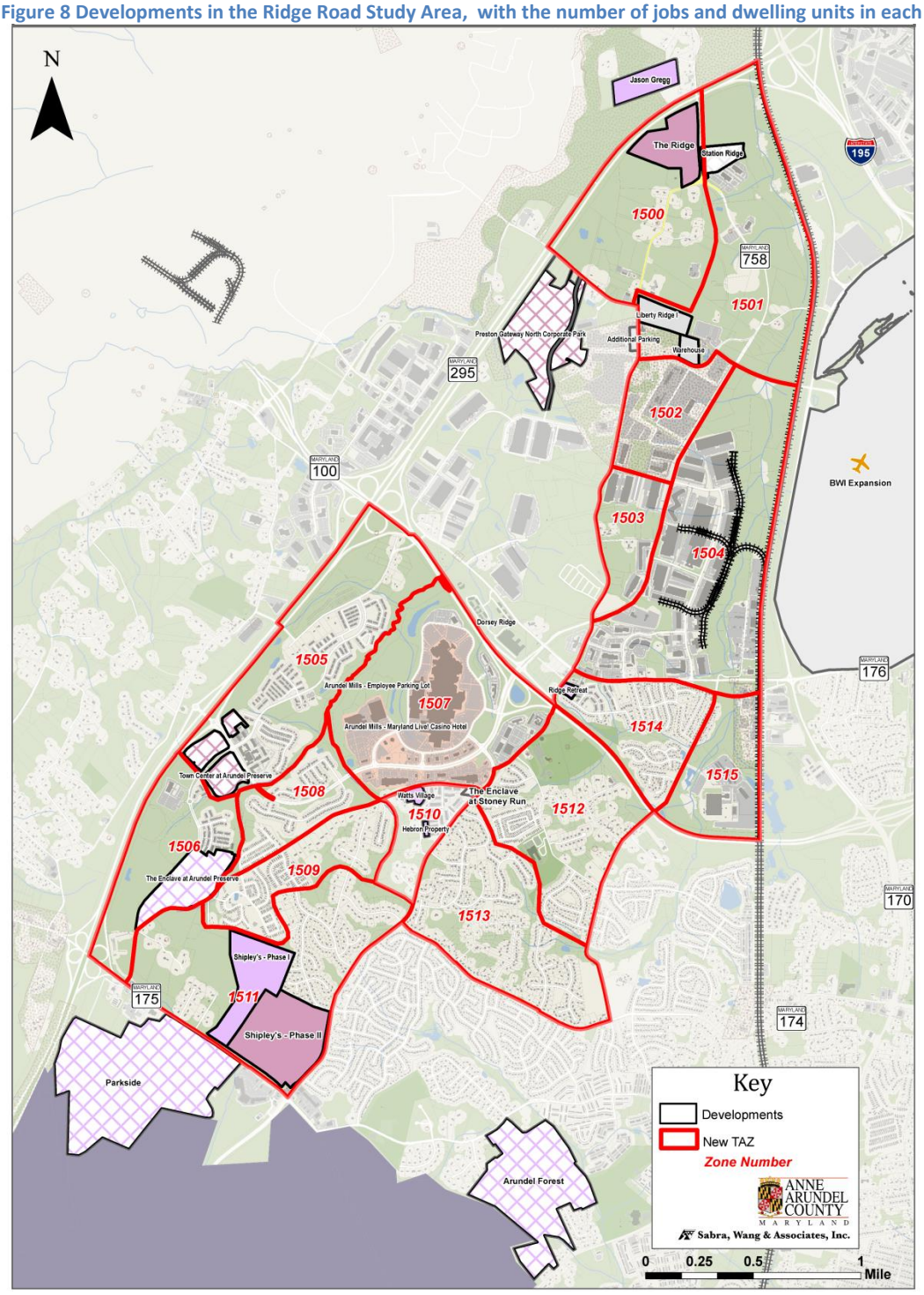


Figure 8 Developments in the Ridge Road Study Area

Table 5. Along the Northern section of Ridge Road there are 4 new developments, a townhouse with a hotel and office buildings, two industrially zoned buildings, and a single family residential area. In total there will be 3500 jobs, and 216 dwelling units. In the southern part of the study area, between MD 100

and MD 175, 1800 jobs and 2800 dwelling units will be created across 10 proposed developments. Developments in zones that were not split were also accounted for.

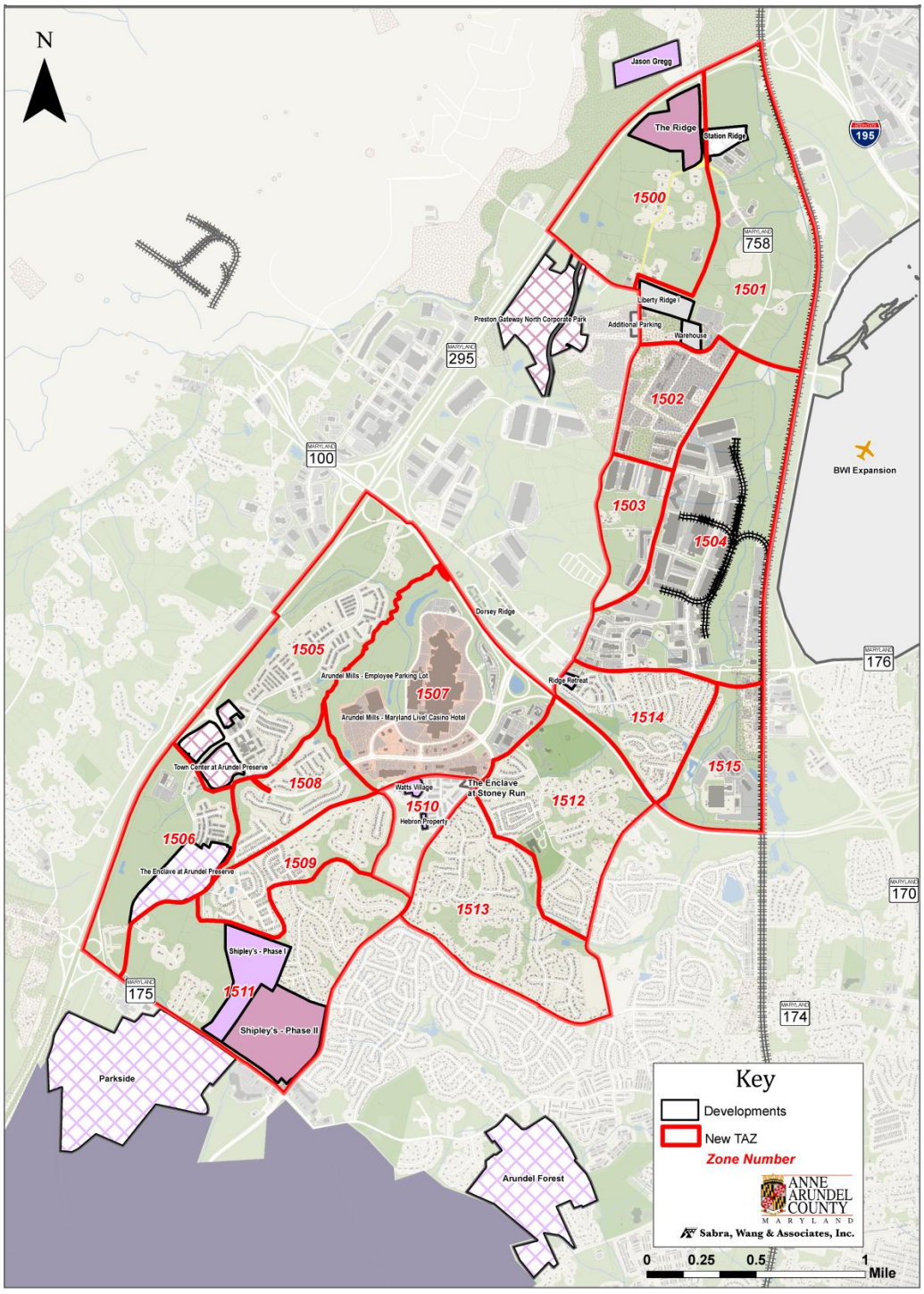


Figure 8 Developments in the Ridge Road Study Area

Table 5 Developments included in transportation demand forecasting

Project Name	Project Type	Jobs	D.U.	TAZ #
Liberty Ridge I	Industrial	660	0	348 / 1501
The Ridge	Mixed-Use	671	210	348 / 1500
Preston Gateway North Corporate Park	Industrial	2226	0	349
Ridge Retreat	Residential	0	6	390 / 1514
Arundel Forest	Residential	0	291	391
Arundel Mills - Employee Parking Lot	Commercial	0	0	399 / 1507
Arundel Mills - Maryland Live! Casino Hotel	Commercial	60	0	399 / 1507
Town Center at Arundel Preserve	Mixed-Use	585	242	400 / 1505
The Enclave at Arundel Preserve	Residential	0	127	400 / 1506
The Commons at Shipley's Homestead	Mixed-Use	1194	831	401 / 1511
Watts Village	Residential	0	52	401 / 1510
Hebron Property	Residential	0	26	401 / 1510
The Enclave at Stoney Run	Residential	0	26	401 / 1510
Parkside	Residential	0	1219	471

A question was raised regarding the Shipley's Homestead development and the significant provides significant new growth it provided in TAZ 1511. When SWA originally analyzed the planned developments and incorporated them into the 2040 TAZ land use forecasts the site plan for the Shipley's Homestead development was not available. Thus, only access onto MD 713 (Ridge Road) was assumed. We now have the site development plans that show 2 access points along MD 713 and 3 planned access points along MD 175. Based upon the site plans and the BMC growth for the zone we can assume that all of the growth in TAZ 1511 is due to the Shipley's Homestead. The forecast volumes for TAZ 1511 grow from 2073 in/out in 2017 to 14367 in/out in 2040. This amounts to approximately 12,300 vehicle trips added to the network. When we analyzed the roads used based on where the vehicle trips for TAZ 1511 are coming from and going to (using select link analyses) we found that 25% of the trips utilized MD 713 from the North to reach/leave TAZ 1511, 56% utilized MD 175 from the West, 15% utilized MD 175 from the East, and 4 % came from the Fort Meade TAZs to the South. This would lower the daily trips entering/exiting TAZ 1511 from MD 173 by ~ 8,000 (assuming ½ of the trips from the south and east would still use Ridge Road), or 800 trips in the Peak Hours. These adjustments will be

made in the traffic/turning movement analysis. The number of trips going to and from zone 1511 in the year 2040 was determined for the north, west, east, and Fort Meade approaches, seen in Table 6.

Table 6 2040 Approach Volumes to/from TAZ 1511

Approach	Approach Volume	Percent of Total
North (MD 713)	3661	25%
West (MD 175)	8007	56%
East (MD 175)	2180	15%
South (Fort Meade)	521	4%

3.2 2017 to 2040 Networks

The BMC 4.4 2040 model included expected improvements to the study area, highlighted in Figure 9 2017 to 2040 Subarea Model Improvements. Most notable is the addition of the MD 295 and Hanover Road Interchange. By 2040 there will be an increase in capacity along MD-175, MD-100 and MD-295. The southern portion of Ridge Road gains a lane in each direction. An interchange at MD-295 and Hanover Road is planned. Hanover Rd will also be connected to Stony Run Road and the functional type will be improved. The functional type of Dorsey Run Road will improve, and US-1 will have lanes added.

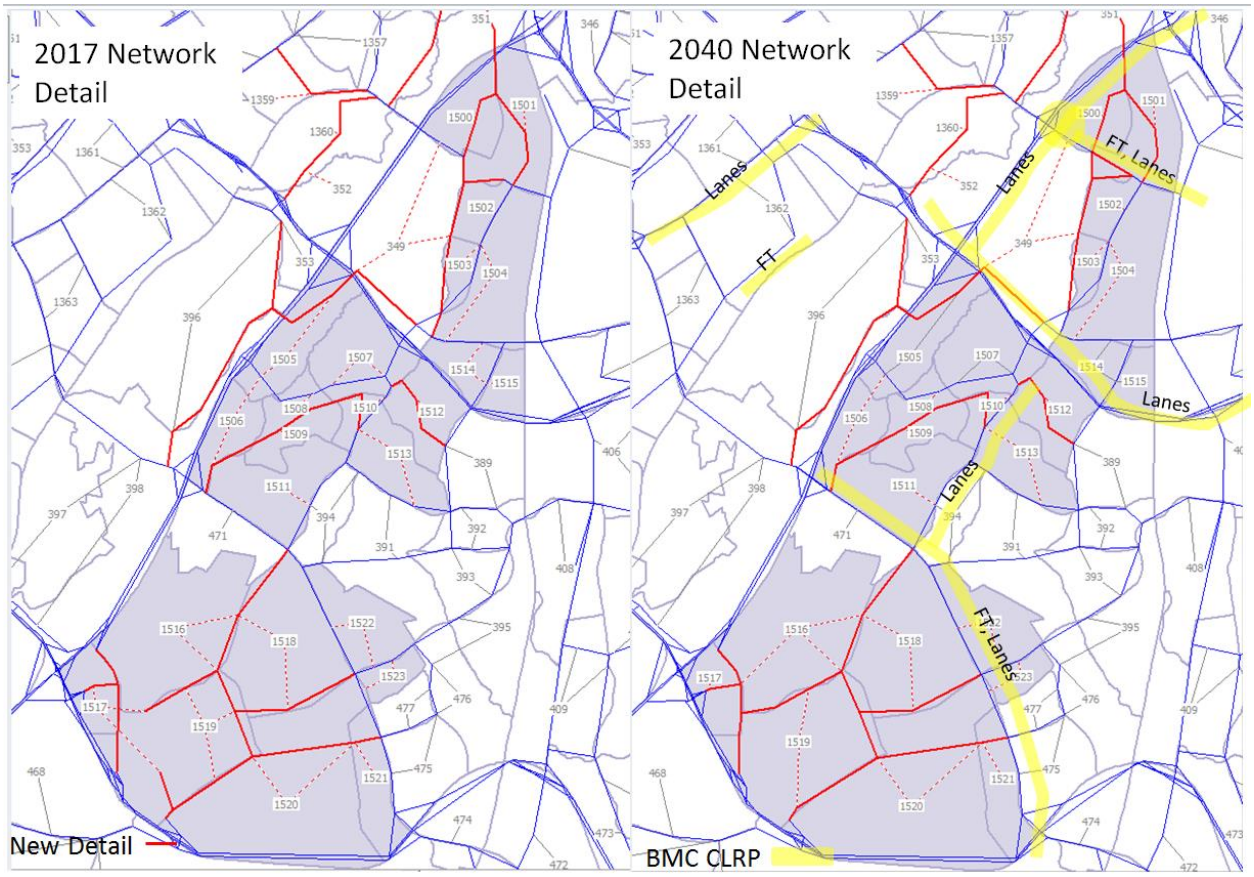


Figure 9 2017 to 2040 Subarea Model Improvements

4 Future Year Forecasts and Growth

Future year volumes were forecasted with the proposed network changes in place. Figure 6 compares the 2017 and 2040 subarea model volumes. Table 4 shows the annual and total growth percentages for the Ridge Road corridor. The growth rates for each segment were input into NCHRP 765 post processing to create future year turning movement counts.

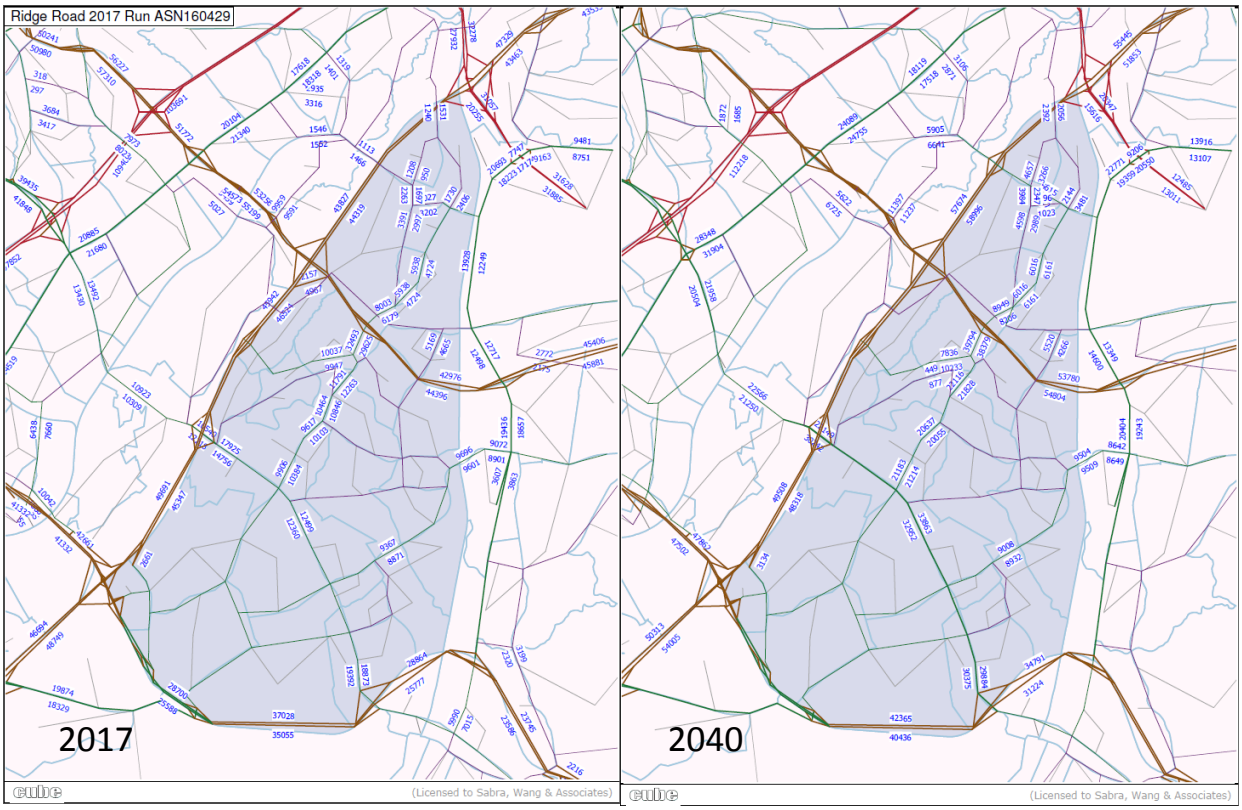


Figure 10 Subarea Model, 2017 and Forecasted 2040 Average Weekday Traffic Volumes

Table 7 Forecast Average Weekday Traffic Growth

Roadway	Segment		Base Year	Forecast 2040	% Annual Increase	% Increase 2017-2040
	From	To				
Ridge Rd	MD 175	Metacomet Rd	20,300	34,400	3.0%	69%
	Severn Rd	Watts Ave	21,300	41,100	4.0%	93%
	New Ridge Rd	Stoney Run Rd	6,400	7,600	0.8%	19%
	Stoney Run Rd	Hanover Rd	4,000	6,300	2.5%	58%
	Hanover Rd	Corporate Center Dr	6,400	7,600	0.8%	19%
	Corporate Center Dr	German Driveway	2,800	4,500	2.6%	61%
New Ridge Rd	Dorsey Rd	Ridge Rd	14,200	17,200	0.9%	21%
	Ridge Rd	Charwood Rd	10,700	12,200	0.6%	14%
	Stoney Run Rd	Ridge Rd	4,100	5,600	1.6%	37%
Arundel Mills Blvd	Ridge Rd	MD 100 Ramps	62,100	78,200	1.1%	26%
Hanover Rd	Ridge Rd	Race Rd	2,600	33,000	50.8%	1169%
MD 175	Disney Rd	Reece Rd	25,900	66,800	6.9%	158%
				Adjusted for Shipley's Homestead		

A question was also raised regarding the growth on specific segments in the study area. Hanover road is increasing due to the new interchange. MD 175 is also increasing to the east, but this does not seem to

be across the whole western side of the study area. We suspect it is due to path diversions from Fort Meade. Along Ridge Road, especially just North of MD 175 there is also greater than 1% growth per year, but there is also significant development. A screenline comparison and check on future growth was therefore carried out. As shown in Figure 11 these check the North South volumes crossing the study area in the South (1a, 1), the Middle (3a, 3), and the North (2), and the East West Volumes from the East (4) and the West (5). The growth for each screenline is shown in Table 8. As shown the North South growth varies between 0.76% in the South to 1.44% in the North. This makes sense based on the new growth in the North part of the study area, where there is relatively little now. The East West growth (2.33%) is most significant just east of MD 295, primarily due to the new interchange at Hanover. The growth to the West is low at 0.78%.

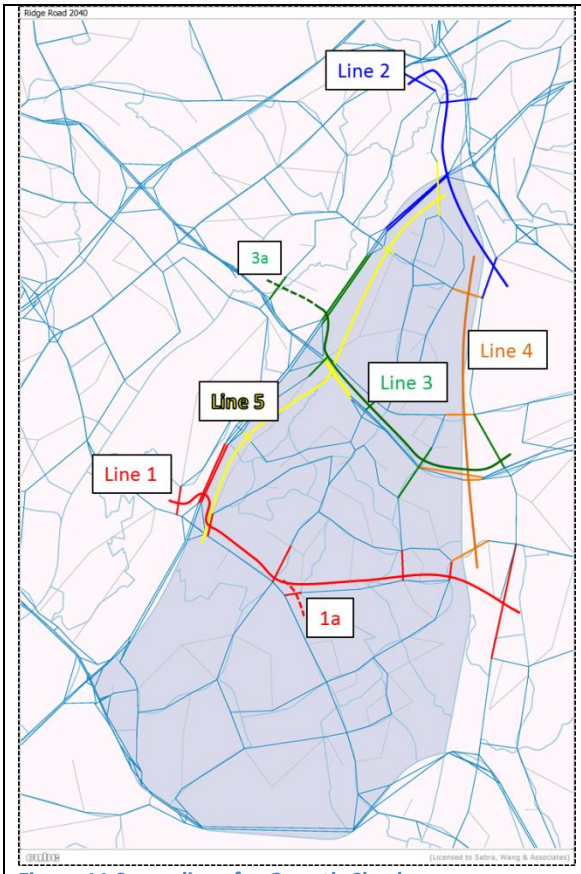


Figure 11 Screenlines for Growth Check

Table 8 Screenline Growth Check

	Screenline totals				Annual
	2017	2040	Difference	% Difference	% Growth
1	178,670	210,072	31,402	18%	0.76%
1a	126,436	151,192	24,756	20%	0.85%
2	137,906	183,559	45,653	33%	1.44%
3	188,007	229,771	41,764	22%	0.97%
3a	168,457	207,137	38,680	23%	1.00%
4	157,348	185,720	28,372	18%	0.78%
5	170,401	261,754	91,353	54%	2.33%

Existing and Future Year AWDT for the network are shown in the following two figures.

Figure 12: Existing Year AWDT Plot

Figure 13: Future Year 2040 AWDT Plot

Appendix B:

Existing, 2040 No build, and Recommended Design CLV Spreadsheets

Appendix B:

Existing, 2040 No build, and Recommended Design CLV Spreadsheets

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd and Hanover Rd

Conditions: Existing

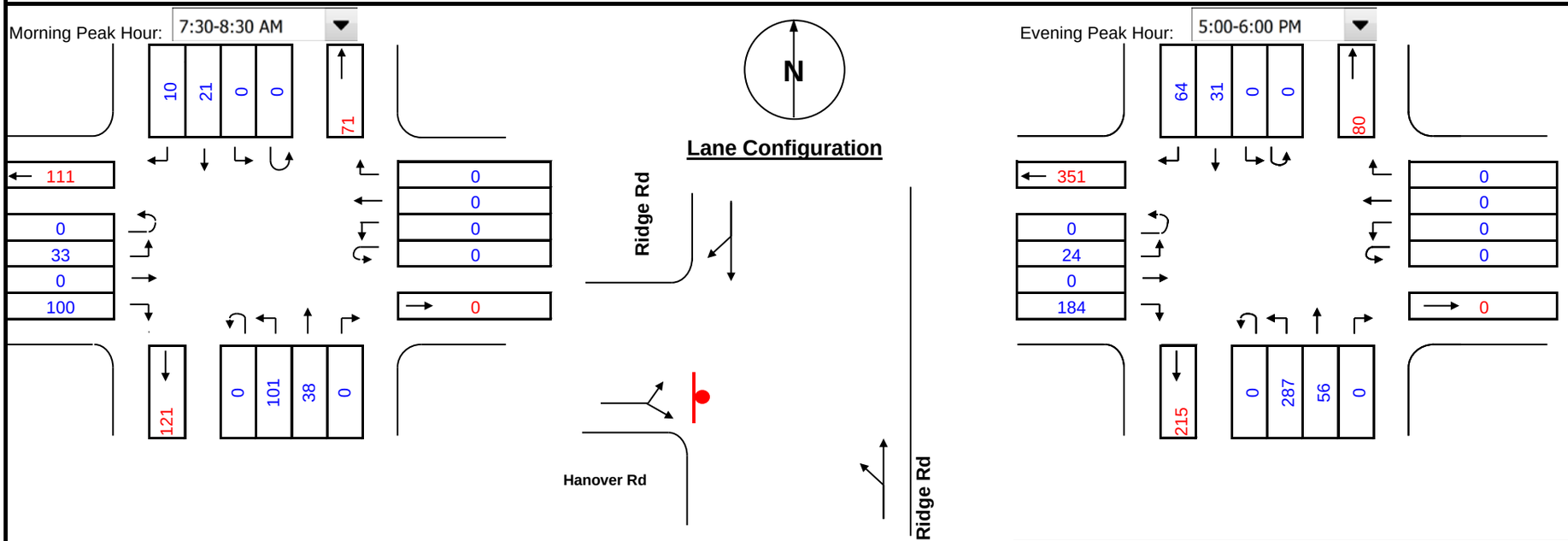
Design Year: 2015

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1	= 1.00	A	<= 1000	<= 199	1.1
2	= 0.55	B	<= 1150	<= 599	2.0
3	= 0.40	C	<= 1300	<= 799	3.0
4	= 0.30	D	<= 1450	<= 999	4.0
5	= 0.25	E	<= 1600	> 1000	5.0
Dbl-Lt	= 0.60	F	> 1600		

Phasing

RTOR/Overlap
- [ ] Northbound
- [x] Southbound
- [x] Eastbound
- [ ] Westbound

Split Phasing
- ( ) East/West
- ( ) North/South
- (•) None

Inx. Control
- ( ) Signal
- (•) Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	149	1.00	149	0	149	*
	SB	31	1.00	31	101	132	
	EB	133	1.00	133	0	133	*
	WB	0	0.00	0	0	0	

Remarks:

* Critical volume Total **282**

Level of service (V/C) **0.18** **A**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	372	1.00	372	0	372	
	SB	95	1.00	95	287	382	*
	EB	208	1.00	208	0	208	*
	WB	0	0.00	0	0	0	

Remarks:

* Critical volume Total **590**

Level of service (V/C) **0.37** **A**

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd at Stoney Run Rd

Conditions: Existing

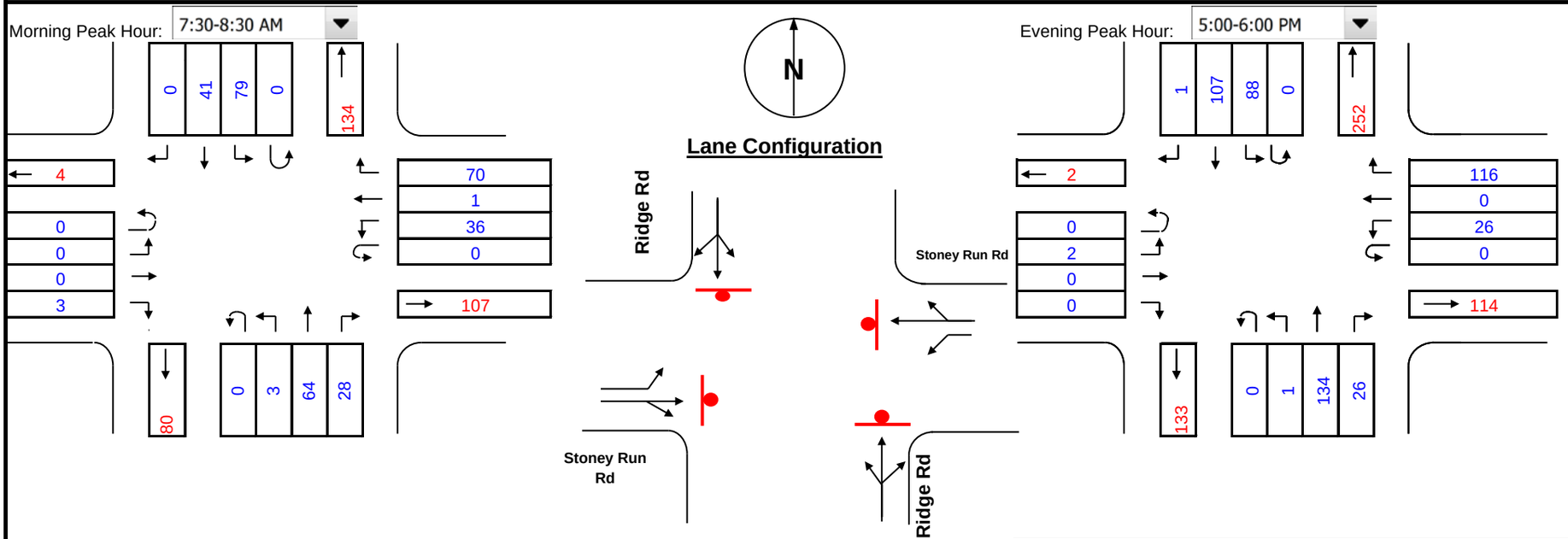
Design Year: 2015

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1	= 1.00	A	<= 1000	<= 199	1.1
2	= 0.55	B	<= 1150	<= 599	2.0
3	= 0.40	C	<= 1300	<= 799	3.0
4	= 0.30	D	<= 1450	<= 999	4.0
5	= 0.25	E	<= 1600	> 1000	5.0
Dbl-Lt	= 0.60	F	> 1600		

Phasing

RTOR/Overlap
- ☐ Northbound
- ☐ Southbound
- ☑ Eastbound
- ☐ Westbound

Split Phasing
- ○ East/West
- ○ North/South
- ◉ None

Inx. Control
- ○ Signal
- ◉ Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	95	1.00	95	79	174	*
	SB	128	1.00	128	3	131	
	EB	3	1.00	3	36	39	
	WB	71	1.00	71	0	71	*

Remarks:

* Critical volume Total **245**

Level of service (V/C) **0.15** **A**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	161	1.00	161	88	249	*
	SB	205	1.00	205	1	206	
	EB	2	1.00	2	26	28	
	WB	116	1.00	116	2	118	*

Remarks:

* Critical volume Total **367**

Level of service (V/C) **0.23** **A**

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd at New Ridge Rd

Conditions: Existing

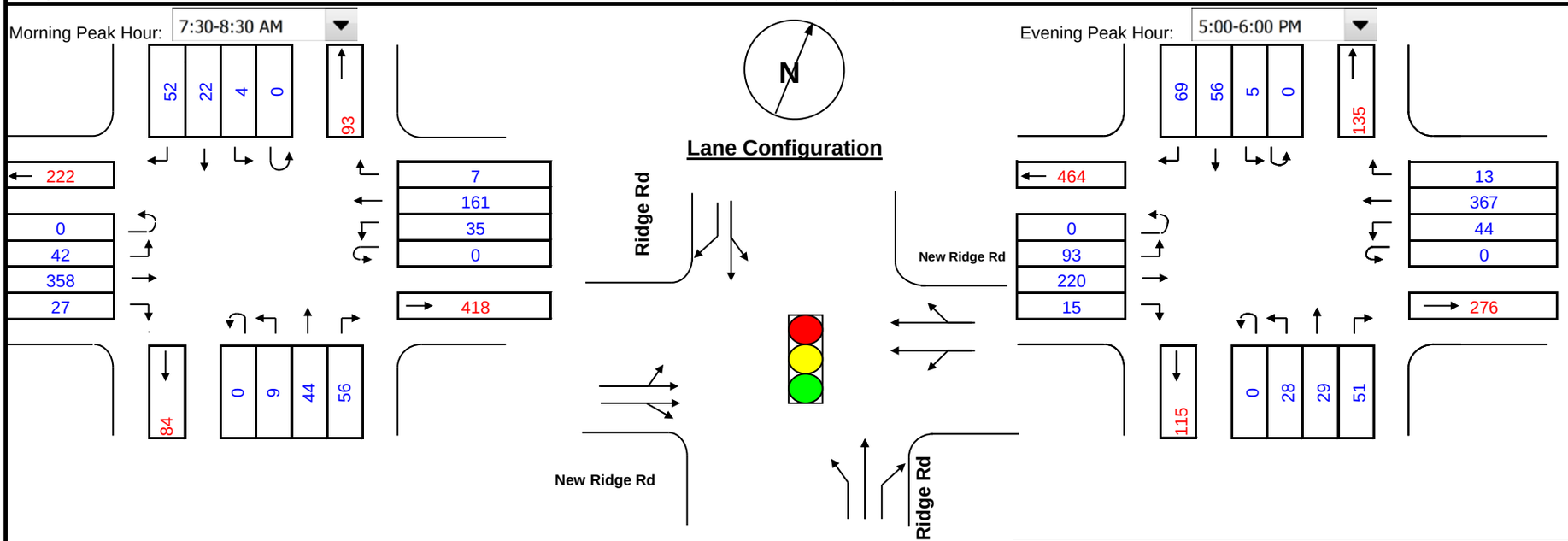
Design Year: 2015

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1	= 1.00	A	<= 1000	<= 199	1.1
2	= 0.55	B	<= 1150	<= 599	2.0
3	= 0.40	C	<= 1300	<= 799	3.0
4	= 0.30	D	<= 1450	<= 999	4.0
5	= 0.25	E	<= 1600	> 1000	5.0
Dbl-Lt	= 0.60	F	> 1600		

Phasing

RTOR/Overlap
- [x] Northbound
- [x] Southbound
- [ ] Eastbound
- [ ] Westbound

Split Phasing
- ( ) East/West
- ( ) North/South
- (•) None

Inx. Control
- (•) Signal
- ( ) Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	44	1.00	44	4	48	*
	SB	26	1.00	26	9	35	
	EB	431	0.55	237	35	272	*
	WB	238	0.55	131	42	173	

Remarks:

* Critical volume Total **320**

Level of service (V/C) **0.20** **A**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	29	1.00	29	5	34	
	SB	62	1.00	62	28	90	*
	EB	421	0.55	232	44	276	
	WB	468	0.55	257	93	350	*

Remarks:

* Critical volume Total **440**

Level of service (V/C) **0.27** **A**

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd at Dorsey Rd (MD 176)

Conditions: Existing

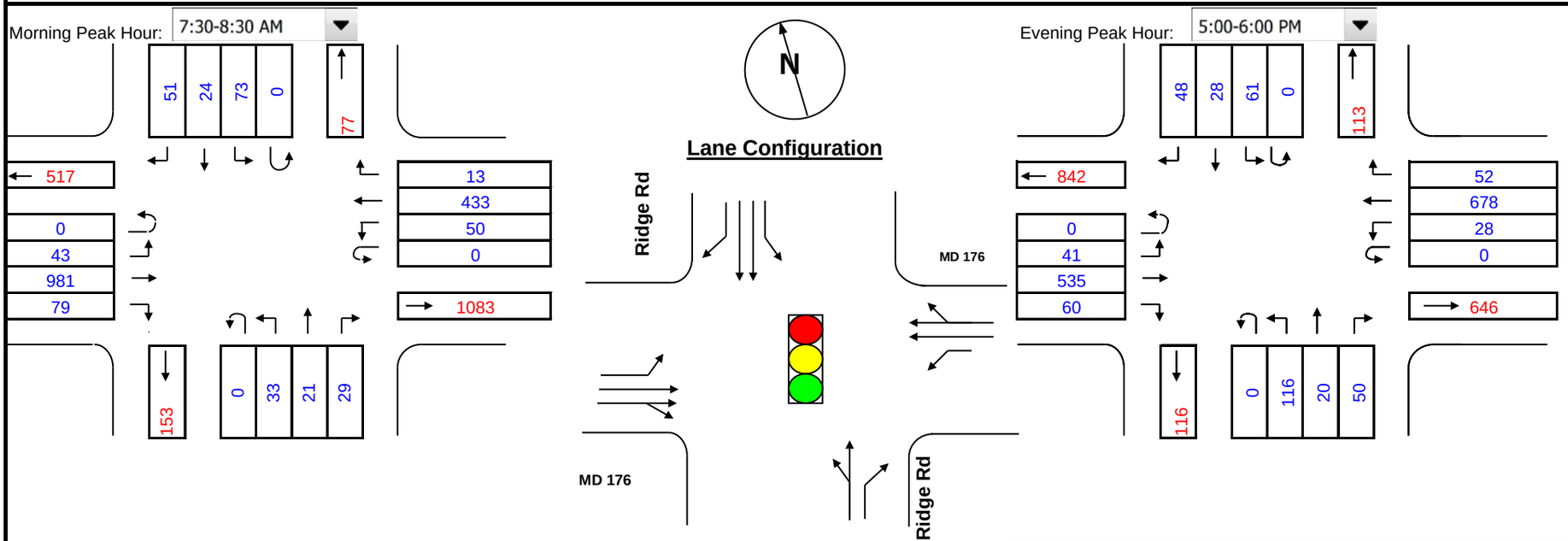
Design Year: 2015

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1	= 1.00	A	<= 1000	<= 199	1.1
2	= 0.55	B	<= 1150	<= 599	2.0
3	= 0.40	C	<= 1300	<= 799	3.0
4	= 0.30	D	<= 1450	<= 999	4.0
5	= 0.25	E	<= 1600	> 1000	5.0
Dbl-Lt	= 0.60	F	> 1600		

Phasing

RTOR/Overlap
- [x] Northbound
- [x] Southbound
- [ ] Eastbound
- [ ] Westbound

Split Phasing
- ( ) East/West
- ( ) North/South
- (•) None

Inx. Control
- (•) Signal
- ( ) Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	57	1.00	57	73	130	*
	SB	24	0.55	13	33	46	
	EB	1060	0.55	583	50	633	*
	WB	446	0.55	245	43	288	

Remarks:

* Critical volume Total **763**

Level of service (V/C) **0.48** **A**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	148	1.00	148	61	209	*
	SB	22	1.00	22	116	138	
	EB	595	0.55	327	28	355	
	WB	730	0.55	402	41	443	*

Remarks:

* Critical volume Total **651**

Level of service (V/C) **0.41** **A**

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd and Hanover Rd

Conditions: Build

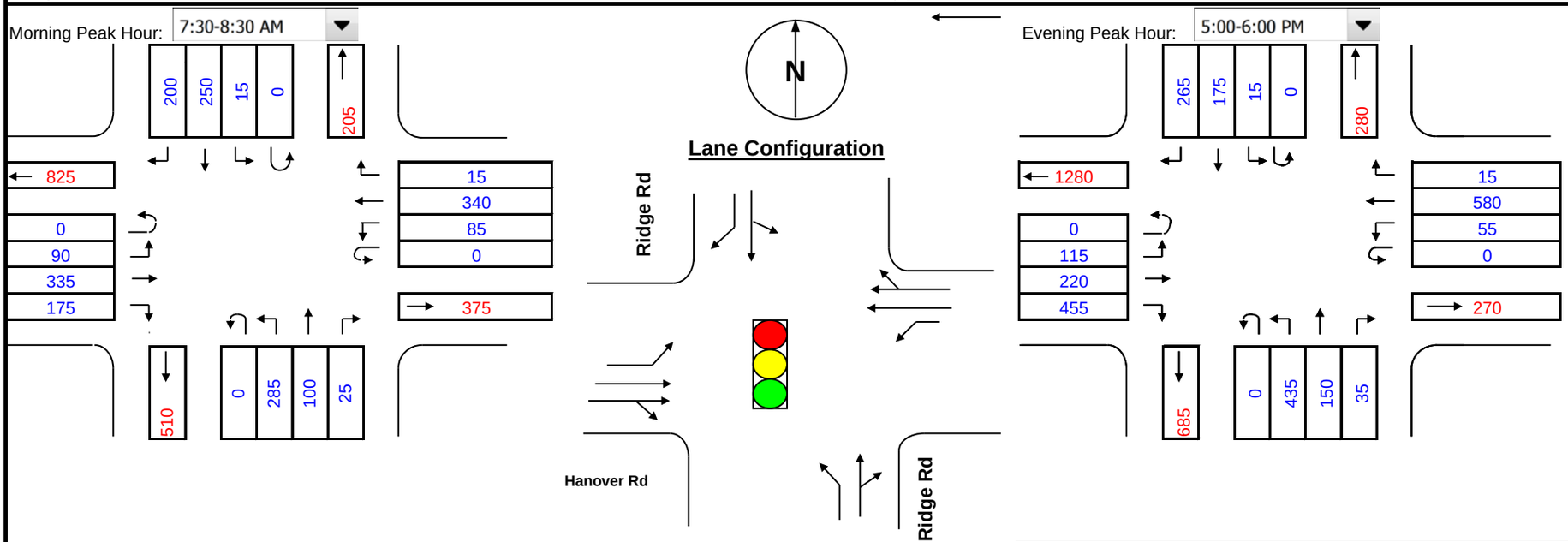
Design Year: 2040

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1 =	1.00	A <=	1000	<= 199	1.1
2 =	0.55	B <=	1150	<= 599	2.0
3 =	0.40	C <=	1300	<= 799	3.0
4 =	0.30	D <=	1450	<= 999	4.0
5 =	0.25	E <=	1600	> 1000	5.0
Dbl-Lt =	0.60	F >	1600		

Phasing

RTOR/Overlap
- [ ] Northbound
- [x] Southbound
- [ ] Eastbound
- [ ] Westbound

Split Phasing
- ( ) East/West
- ( ) North/South
- (•) None

Inx. Control
- (•) Signal
- ( ) Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	125	1.00	125	15	140	
	SB	267	1.00	267	285	552	*
	EB	510	0.55	281	85	366	*
	WB	355	0.55	195	90	285	

Remarks:

* Critical volume Total **917**

Level of service (V/C) **0.57** **A**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	185	1.00	185	15	200	
	SB	192	1.00	192	435	627	*
	EB	675	0.55	371	55	426	
	WB	595	0.55	327	115	442	*

Remarks:

* Critical volume Total **1069**

Level of service (V/C) **0.67** **B**

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd at Stoney Run Rd

Conditions: Build

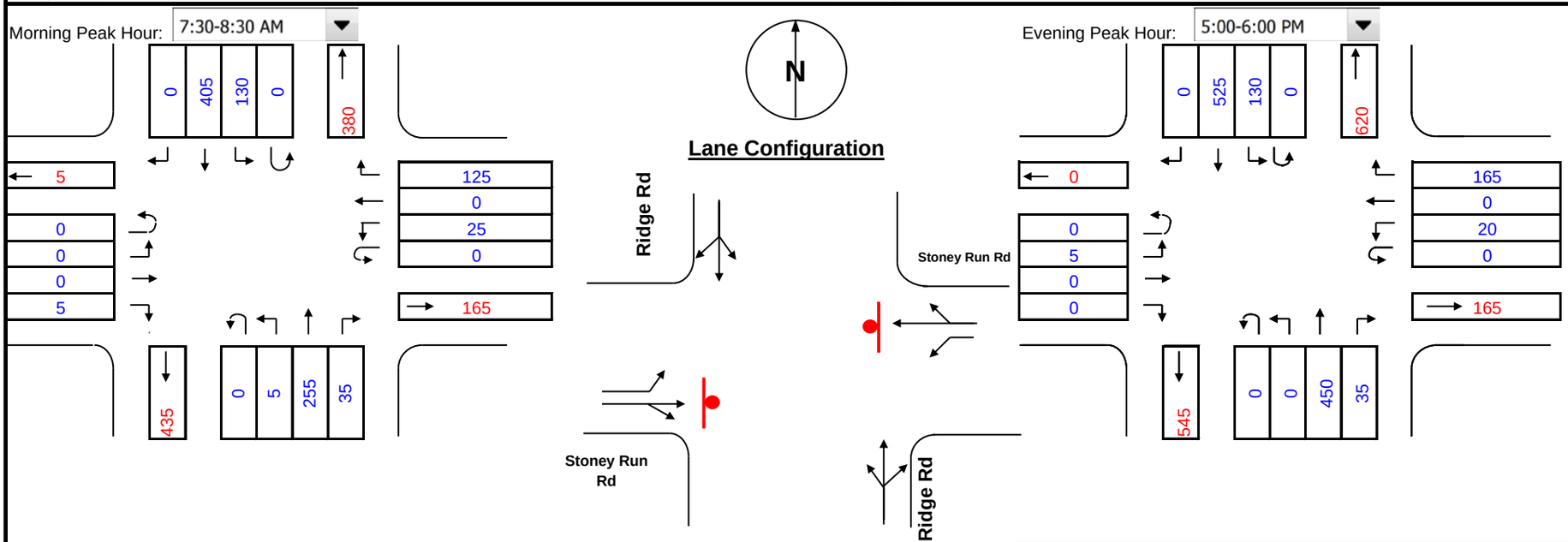
Design Year: 2040

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1	= 1.00	A	<= 1000	<= 199	1.1
2	= 0.55	B	<= 1150	<= 599	2.0
3	= 0.40	C	<= 1300	<= 799	3.0
4	= 0.30	D	<= 1450	<= 999	4.0
5	= 0.25	E	<= 1600	> 1000	5.0
Dbl-Lt	= 0.60	F	> 1600		

Phasing

RTOR/Overlap
- ☐ Northbound
- ☐ Southbound
- ☐ Eastbound
- ☐ Westbound

Split Phasing
- ○ East/West
- ○ North/South
- ◉ None

Inx. Control
- ○ Signal
- ◉ Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	300	1.00	300	130	430	
	SB	665	1.00	665	5	670	*
	EB	5	1.00	5	25	30	
	WB	125	1.00	125	0	125	*

Remarks:

* Critical volume Total **795**

Level of service (V/C) **0.50** **A**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	485	1.00	485	130	615	
	SB	785	1.00	785	0	785	*
	EB	0	1.00	0	20	20	
	WB	165	1.00	165	5	170	*

Remarks:

* Critical volume Total **955**

Level of service (V/C) **0.60** **A**

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd and Hanover Rd

Conditions: No-Build

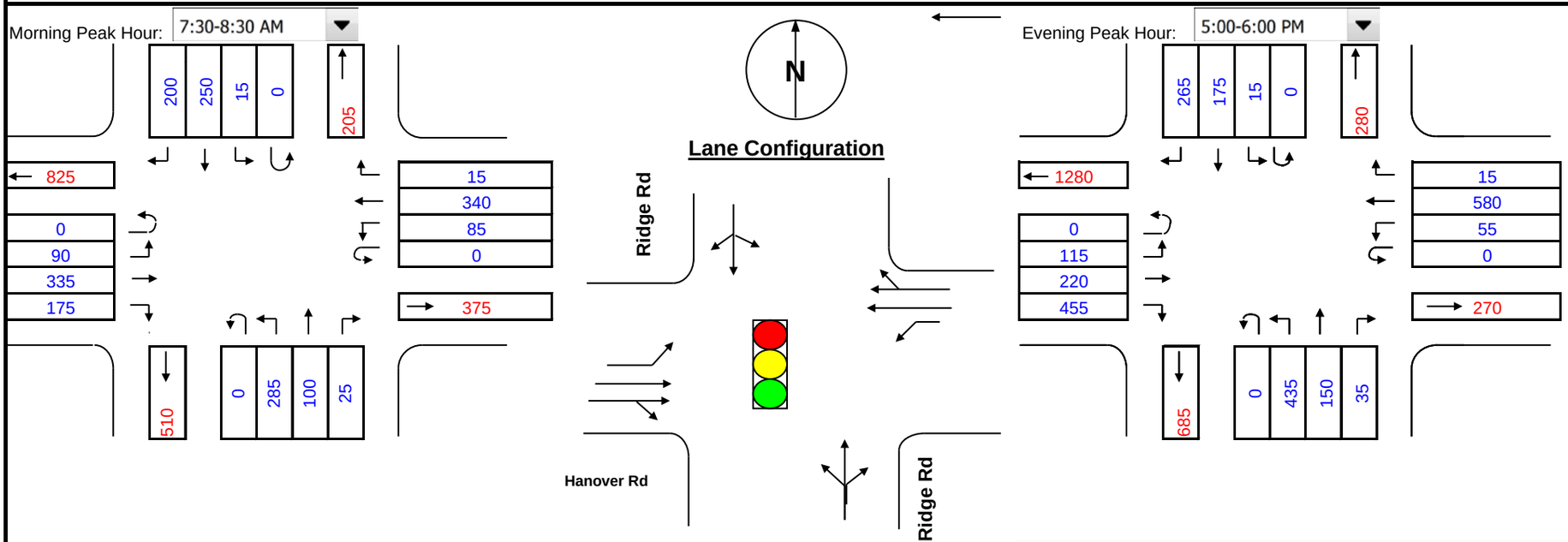
Design Year: 2040

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1	= 1.00	A	<= 1000	<= 199	1.1
2	= 0.55	B	<= 1150	<= 599	2.0
3	= 0.40	C	<= 1300	<= 799	3.0
4	= 0.30	D	<= 1450	<= 999	4.0
5	= 0.25	E	<= 1600	> 1000	5.0
Dbl-Lt	= 0.60	F	> 1600		

Phasing

RTOR/Overlap
- ☐ Northbound
- ☐ Southbound
- ☐ Eastbound
- ☐ Westbound

Split Phasing
- ○ East/West
- ○ North/South
- ◉ None

Inx. Control
- ○ Signal
- ◉ Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	695	1.00	695	15	710	
	SB	467	1.00	467	285	752	*
	EB	510	0.55	281	85	366	*
	WB	355	0.55	195	90	285	

Remarks:

* Critical volume Total **1117**

Level of service (V/C) **0.70** **B**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	1055	1.00	1055	15	1070	*
	SB	457	1.00	457	435	892	
	EB	675	0.55	371	55	426	
	WB	595	0.55	327	115	442	*

Remarks:

* Critical volume Total **1512**

Level of service (V/C) **0.95** **E**

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd at Stoney Run Rd

Conditions: No-Build

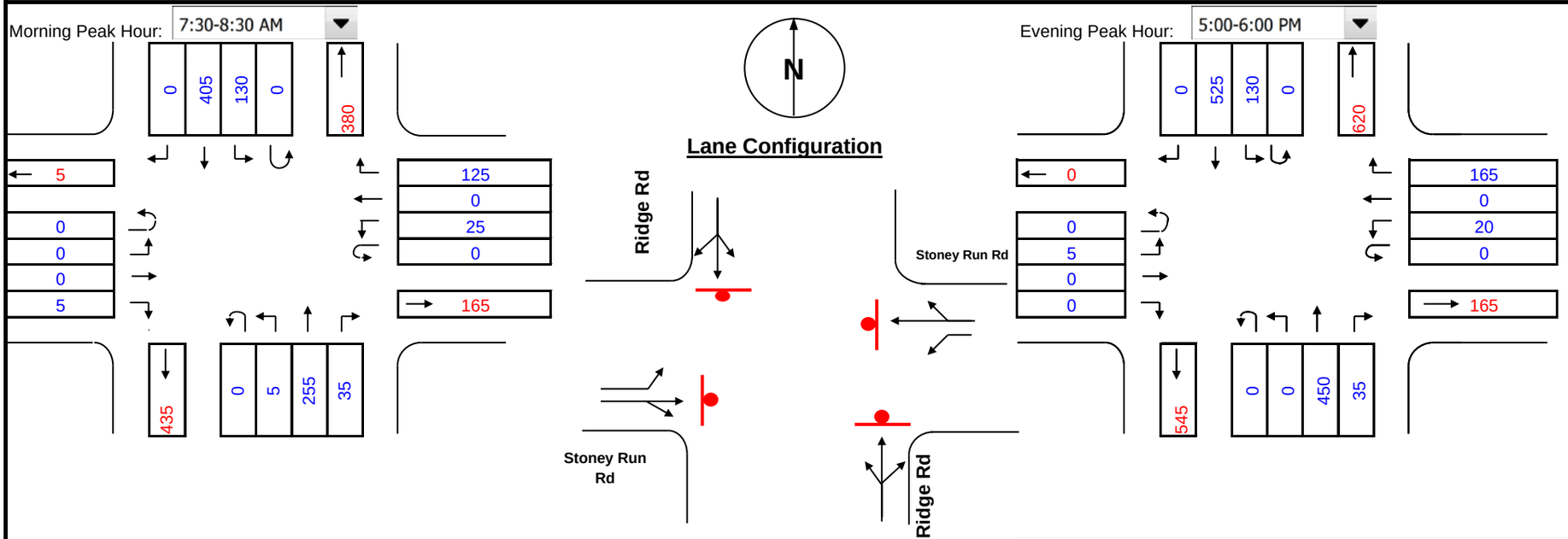
Design Year: 2040

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1	= 1.00	A	<= 1000	<= 199	1.1
2	= 0.55	B	<= 1150	<= 599	2.0
3	= 0.40	C	<= 1300	<= 799	3.0
4	= 0.30	D	<= 1450	<= 999	4.0
5	= 0.25	E	<= 1600	> 1000	5.0
Dbl-Lt	= 0.60	F	> 1600		

Phasing

RTOR/Overlap
- ☐ Northbound
- ☐ Southbound
- ☐ Eastbound
- ☐ Westbound

Split Phasing
- ○ East/West
- ○ North/South
- ◉ None

Inx. Control
- ○ Signal
- ◉ Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	300	1.00	300	130	430	
	SB	665	1.00	665	5	670	*
	EB	5	1.00	5	25	30	
	WB	125	1.00	125	0	125	*

Remarks:

* Critical volume Total **795**

Level of service (V/C) **0.50** **A**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	485	1.00	485	130	615	
	SB	785	1.00	785	0	785	*
	EB	0	1.00	0	20	20	
	WB	165	1.00	165	5	170	*

Remarks:

* Critical volume Total **955**

Level of service (V/C) **0.60** **A**

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd at New Ridge Rd

Conditions: No-Build

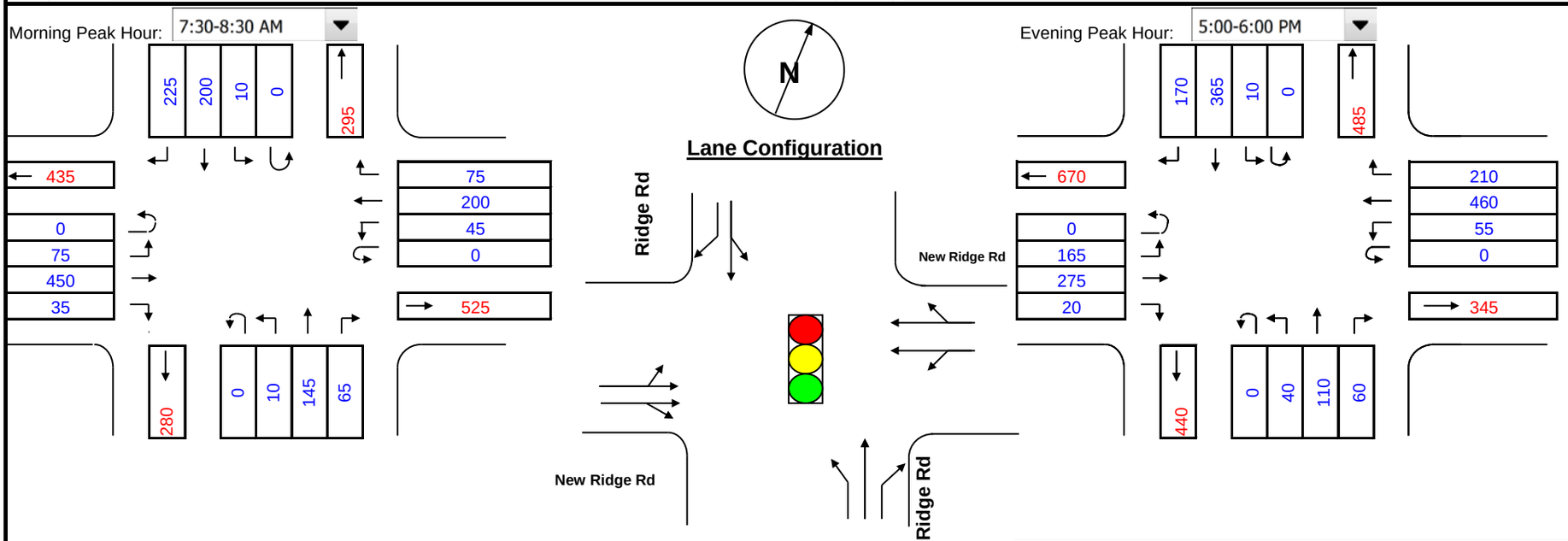
Design Year: 2040

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1	= 1.00	A	<= 1000	<= 199	1.1
2	= 0.55	B	<= 1150	<= 599	2.0
3	= 0.40	C	<= 1300	<= 799	3.0
4	= 0.30	D	<= 1450	<= 999	4.0
5	= 0.25	E	<= 1600	> 1000	5.0
Dbl-Lt	= 0.60	F	> 1600		

Phasing

RTOR/Overlap
- [x] Northbound
- [x] Southbound
- [ ] Eastbound
- [ ] Westbound

Split Phasing
- ( ) East/West
- ( ) North/South
- (•) None

Inx. Control
- (•) Signal
- ( ) Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	145	1.00	145	10	155	
	SB	220	1.00	220	10	230	*
	EB	635	0.55	349	45	394	*
	WB	365	0.55	201	75	276	

Remarks:

* Critical volume Total **624**

Level of service (V/C) **0.39** **A**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	110	1.00	110	10	120	
	SB	376	1.00	376	40	416	*
	EB	790	0.55	435	55	490	
	WB	780	0.55	429	165	594	*

Remarks:

* Critical volume Total **1010**

Level of service (V/C) **0.63** **B**

Maryland State Highway Administration
Turning Movement Summary and Level of Service

Prepared by: **Sabra, Wang & Associates, Inc.**

Count Date:

Location: Ridge Rd at Dorsey Rd (MD 176)

Conditions: No-Build

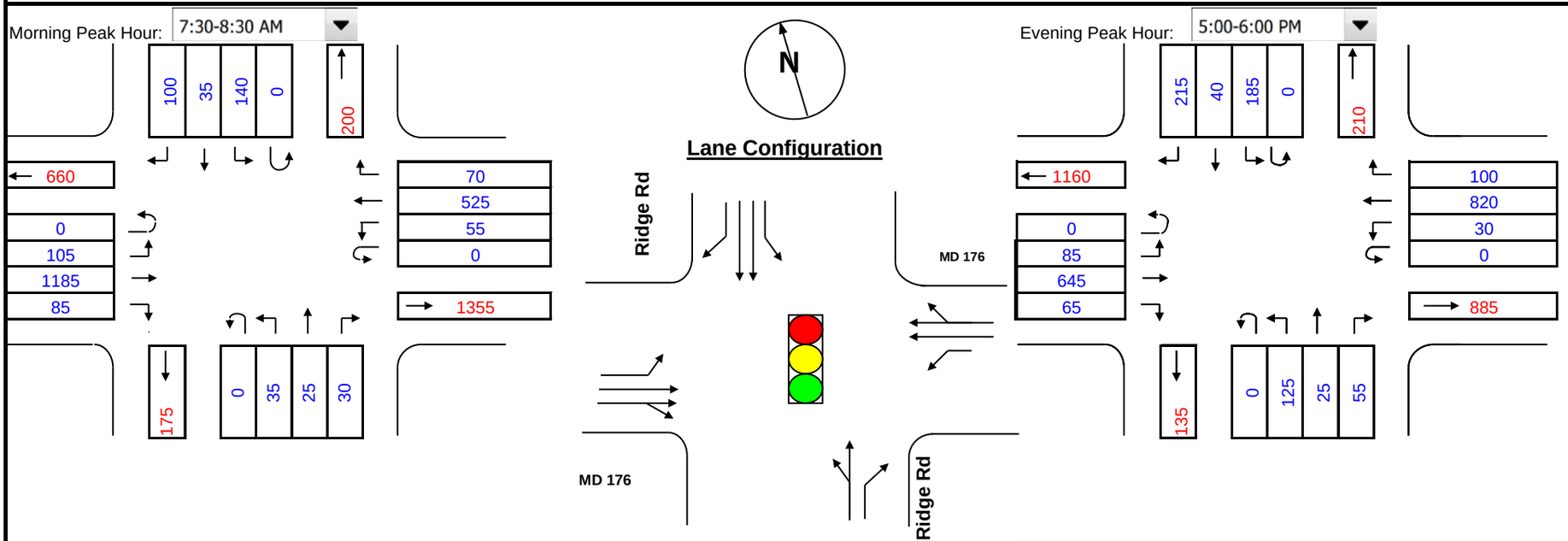
Design Year: 2040

Computed by: JC

Date 8/15/2016

Morning Peak Hour: 7:30-8:30 AM

Evening Peak Hour: 5:00-6:00 PM



Number of Lanes	Lane Use Factor	Service Level	Critical Lane Vol	Opposing Volume (VPH)	PCE
1 =	1.00	A <=	1000	<= 199	1.1
2 =	0.55	B <=	1150	<= 599	2.0
3 =	0.40	C <=	1300	<= 799	3.0
4 =	0.30	D <=	1450	<= 999	4.0
5 =	0.25	E <=	1600	> 1000	5.0
Dbl-Lt =	0.60	F >	1600		

Phasing

RTOR/Overlap
- [x] Northbound
- [x] Southbound
- [ ] Eastbound
- [ ] Westbound

Split Phasing
- ( ) East/West
- ( ) North/South
- (•) None

Inx. Control
- (•) Signal
- ( ) Stop

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. volume	*
	NB	64	1.00	64	140	204	*
	SB	35	0.55	19	35	54	
	EB	1270	0.55	699	55	754	*
	WB	595	0.55	327	105	432	

Remarks:

* Critical volume Total **957**

Level of service (V/C) **0.60** **A**

Phase	Movement	Volume 1	Lane Use Factor - 2	Lane volume 1 X 2	Opposing Movement	Critical ln. Volume	*
	NB	275	1.00	275	185	460	*
	SB	25	1.00	25	125	150	
	EB	710	0.55	391	30	421	
	WB	920	0.55	506	85	591	*

Remarks:

* Critical volume Total **1051**

Level of service (V/C) **0.66** **B**

Appendix C:

Existing, 2040 No build, and Recommended Design HCM Reports

Appendix C:

Existing, 2040 No build, and Recommended Design HCM Reports

LANE SUMMARY

Site: Ridge Road at Corporate Center Dr - AM

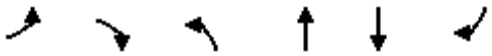
New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
SouthEast: Corporate Center Dr													
Lane 1[d]	61	0.0	1082	0.056	100	3.8	LOS A	0.2	5.0	Full	1600	0.0	0.0
Approach	61	0.0		0.056		3.8	LOS A	0.2	5.0				
North: Ridge Rd													
Lane 1[d]	41	0.0	1094	0.038	100	3.6	LOS A	0.1	3.3	Full	1600	0.0	0.0
Approach	41	0.0		0.038		3.6	LOS A	0.1	3.3				
West: Ridge Rd													
Lane 1[d]	75	0.0	1123	0.067	100	3.8	LOS A	0.2	6.0	Full	1600	0.0	0.0
Approach	75	0.0		0.067		3.8	LOS A	0.2	6.0				
Intersection	177	0.0		0.067		3.7	LOS A	0.2	6.0				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

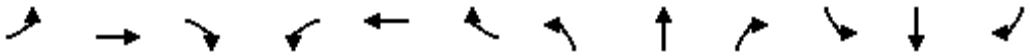
d Dominant lane on roundabout approach



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	33	100	101	38	21	10
Future Volume (Veh/h)	33	100	101	38	21	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	36	109	110	41	23	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	290	28	34			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	290	28	34			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	90	93			
cM capacity (veh/h)	652	1046	1578			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	145	151	34
Volume Left	36	110	0
Volume Right	109	0	11
cSH	910	1578	1700
Volume to Capacity	0.16	0.07	0.02
Queue Length 95th (ft)	14	6	0
Control Delay (s)	9.7	5.6	0.0
Lane LOS	A	A	
Approach Delay (s)	9.7	5.6	0.0
Approach LOS	A		

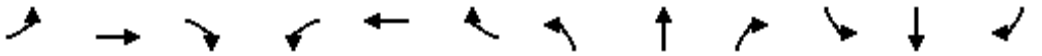
Intersection Summary			
Average Delay	6.8		
Intersection Capacity Utilization	28.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	0	0	3	36	1	70	3	64	28	79	41	0
Future Volume (vph)	0	0	3	36	1	70	3	64	28	79	41	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	3	39	1	76	3	70	30	86	45	0

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	0	3	39	77	103	131
Volume Left (vph)	0	0	39	0	3	86
Volume Right (vph)	0	3	0	76	30	0
Hadj (s)	0.00	-0.67	0.53	-0.66	-0.13	0.17
Departure Headway (s)	5.2	4.5	5.6	4.4	4.2	4.5
Degree Utilization, x	0.00	0.00	0.06	0.09	0.12	0.16
Capacity (veh/h)	900	748	613	778	825	774
Control Delay (s)	7.0	6.3	7.7	6.6	7.8	8.3
Approach Delay (s)	6.3		7.0		7.8	8.3
Approach LOS	A		A		A	A

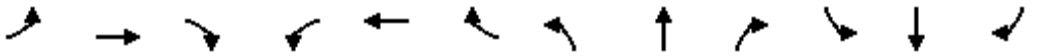
Intersection Summary				
Delay	7.7			
Level of Service	A			
Intersection Capacity Utilization	28.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	42	358	27	35	161	7	9	44	56	4	22	52
Future Volume (vph)	42	358	27	35	161	7	9	44	56	4	22	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor		0.95			0.95		1.00	1.00	1.00		1.00	1.00
Frt		0.99			0.99		1.00	1.00	0.85		1.00	0.85
Flt Protected		1.00			0.99		0.95	1.00	1.00		0.99	1.00
Satd. Flow (prot)		3489			3490		1770	1863	1583		1850	1583
Flt Permitted		0.91			0.86		0.74	1.00	1.00		0.94	1.00
Satd. Flow (perm)		3192			3019		1377	1863	1583		1752	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	46	389	29	38	175	8	10	48	61	4	24	57
RTOR Reduction (vph)	0	4	0	0	2	0	0	0	55	0	0	51
Lane Group Flow (vph)	0	460	0	0	219	0	10	48	6	0	28	6
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4		4	8		8
Actuated Green, G (s)		42.9			42.9		5.9	5.9	5.9		5.9	5.9
Effective Green, g (s)		42.9			42.9		5.9	5.9	5.9		5.9	5.9
Actuated g/C Ratio		0.73			0.73		0.10	0.10	0.10		0.10	0.10
Clearance Time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)		5.0			5.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		2328			2202		138	186	158		175	158
v/s Ratio Prot								c0.03				
v/s Ratio Perm		c0.14			0.07		0.01		0.00		0.02	0.00
v/c Ratio		0.20			0.10		0.07	0.26	0.04		0.16	0.04
Uniform Delay, d1		2.5			2.3		24.0	24.4	23.9		24.2	23.9
Progression Factor		1.00			1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2		0.2			0.0		0.2	0.7	0.1		0.4	0.1
Delay (s)		2.7			2.4		24.2	25.2	24.0		24.6	24.0
Level of Service		A			A		C	C	C		C	C
Approach Delay (s)		2.7			2.4			24.5			24.2	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	7.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	58.8	Sum of lost time (s)	10.0
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	43	981	79	50	433	13	33	21	29	73	24	51
Future Volume (vph)	43	981	79	50	433	13	33	21	29	73	24	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	1.00			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3500		1770	3524			1808	1583	1770	3539	1583
Flt Permitted	0.48	1.00		0.20	1.00			0.80	1.00	0.72	1.00	1.00
Satd. Flow (perm)	886	3500		375	3524			1486	1583	1338	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	47	1066	86	54	471	14	36	23	32	79	26	55
RTOR Reduction (vph)	0	4	0	0	1	0	0	0	29	0	0	49
Lane Group Flow (vph)	47	1148	0	54	484	0	0	59	3	79	26	6
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	1	6		5	2			8			4	
Permitted Phases	6			2			8		8	4		4
Actuated Green, G (s)	52.5	48.9		52.7	49.0			8.5	8.5	8.5	8.5	8.5
Effective Green, g (s)	52.5	48.9		52.7	49.0			8.5	8.5	8.5	8.5	8.5
Actuated g/C Ratio	0.67	0.63		0.67	0.63			0.11	0.11	0.11	0.11	0.11
Clearance Time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	6.0		3.0	6.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	636	2191		319	2210			161	172	145	385	172
v/s Ratio Prot	0.00	c0.33		c0.01	0.14						0.01	
v/s Ratio Perm	0.05			0.11				0.04	0.00	c0.06		0.00
v/c Ratio	0.07	0.52		0.17	0.22			0.37	0.02	0.54	0.07	0.03
Uniform Delay, d1	4.3	8.1		4.8	6.3			32.3	31.1	33.0	31.2	31.1
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.0	0.9		0.3	0.2			1.4	0.0	4.1	0.1	0.1
Delay (s)	4.4	9.0		5.1	6.5			33.7	31.1	37.1	31.3	31.2
Level of Service	A	A		A	A			C	C	D	C	C
Approach Delay (s)		8.8			6.4			32.8			34.1	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	11.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	78.1	Sum of lost time (s)	17.0
Intersection Capacity Utilization	57.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

LANE SUMMARY

Site: Ridge Road at Corporate Center Dr - PM

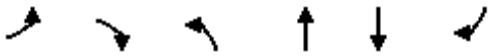
New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
SouthEast: Corporate Center Dr													
Lane 1[d]	59	0.0	1094	0.054	100	3.7	LOS A	0.2	4.8	Full	1600	0.0	0.0
Approach	59	0.0		0.054		3.7	LOS A	0.2	4.8				
North: Ridge Rd													
Lane 1[d]	118	0.0	1073	0.110	100	4.3	LOS A	0.4	10.4	Full	1600	0.0	0.0
Approach	118	0.0		0.110		4.3	LOS A	0.4	10.4				
West: Ridge Rd													
Lane 1[d]	95	0.0	1081	0.087	100	4.1	LOS A	0.3	8.0	Full	1600	0.0	0.0
Approach	95	0.0		0.087		4.1	LOS A	0.3	8.0				
Intersection	272	0.0		0.110		4.1	LOS A	0.4	10.4				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

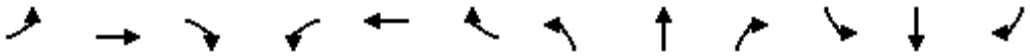
d Dominant lane on roundabout approach



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	24	184	287	56	31	64
Future Volume (Veh/h)	24	184	287	56	31	64
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	26	200	312	61	34	70
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	754	69	104			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	754	69	104			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	91	80	79			
cM capacity (veh/h)	298	994	1488			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	226	373	104
Volume Left	26	312	0
Volume Right	200	0	70
cSH	783	1488	1700
Volume to Capacity	0.29	0.21	0.06
Queue Length 95th (ft)	30	20	0
Control Delay (s)	11.4	7.0	0.0
Lane LOS	B	A	
Approach Delay (s)	11.4	7.0	0.0
Approach LOS	B		

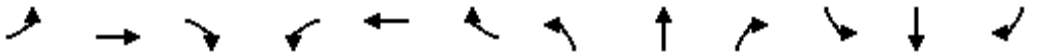
Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	44.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	2	0	0	26	0	116	1	134	26	88	107	1
Future Volume (vph)	2	0	0	26	0	116	1	134	26	88	107	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	0	0	28	0	126	1	146	28	96	116	1

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	2	0	28	126	175	213
Volume Left (vph)	2	0	28	0	1	96
Volume Right (vph)	0	0	0	126	28	1
Hadj (s)	0.53	0.00	0.53	-0.67	-0.06	0.12
Departure Headway (s)	6.1	5.6	5.9	4.7	4.5	4.6
Degree Utilization, x	0.00	0.00	0.05	0.17	0.22	0.27
Capacity (veh/h)	533	900	566	707	770	747
Control Delay (s)	8.0	7.4	8.0	7.5	8.7	9.3
Approach Delay (s)	8.0		7.6		8.7	9.3
Approach LOS	A		A		A	A

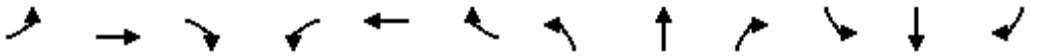
Intersection Summary				
Delay	8.6			
Level of Service	A			
Intersection Capacity Utilization	37.4%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	220	15	44	367	13	28	29	51	5	56	69
Future Volume (vph)	93	220	15	44	367	13	28	29	51	5	56	69
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor		0.95			0.95		1.00	1.00	1.00		1.00	1.00
Frt		0.99			1.00		1.00	1.00	0.85		1.00	0.85
Flt Protected		0.99			0.99		0.95	1.00	1.00		1.00	1.00
Satd. Flow (prot)		3466			3505		1770	1863	1583		1856	1583
Flt Permitted		0.75			0.89		0.71	1.00	1.00		0.97	1.00
Satd. Flow (perm)		2650			3141		1330	1863	1583		1808	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	101	239	16	48	399	14	30	32	55	5	61	75
RTOR Reduction (vph)	0	3	0	0	2	0	0	0	49	0	0	67
Lane Group Flow (vph)	0	353	0	0	459	0	30	32	6	0	66	8
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4		4	8		8
Actuated Green, G (s)		42.9			42.9		6.4	6.4	6.4		6.4	6.4
Effective Green, g (s)		42.9			42.9		6.4	6.4	6.4		6.4	6.4
Actuated g/C Ratio		0.72			0.72		0.11	0.11	0.11		0.11	0.11
Clearance Time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)		5.0			5.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1917			2272		143	201	170		195	170
v/s Ratio Prot								0.02				
v/s Ratio Perm		0.13			c0.15		0.02		0.00		c0.04	0.01
v/c Ratio		0.18			0.20		0.21	0.16	0.03		0.34	0.05
Uniform Delay, d1		2.6			2.7		24.1	24.0	23.7		24.5	23.7
Progression Factor		1.00			1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2		0.2			0.1		0.7	0.4	0.1		1.0	0.1
Delay (s)		2.8			2.7		24.9	24.4	23.8		25.5	23.8
Level of Service		A			A		C	C	C		C	C
Approach Delay (s)		2.8			2.7			24.2			24.6	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	8.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.22		
Actuated Cycle Length (s)	59.3	Sum of lost time (s)	10.0
Intersection Capacity Utilization	54.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	41	535	60	28	678	52	116	20	50	61	28	48
Future Volume (vph)	41	535	60	28	678	52	116	20	50	61	28	48
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00	1.00	0.95	1.00
Frt	1.00	0.98		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3486		1770	3501			1787	1583	1770	3539	1583
Flt Permitted	0.31	1.00		0.40	1.00			0.74	1.00	0.65	1.00	1.00
Satd. Flow (perm)	578	3486		750	3501			1370	1583	1209	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	45	582	65	30	737	57	126	22	54	66	30	52
RTOR Reduction (vph)	0	6	0	0	4	0	0	0	45	0	0	43
Lane Group Flow (vph)	45	641	0	30	790	0	0	148	9	66	30	9
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	1	6		5	2			8			4	
Permitted Phases	6			2			8		8	4		4
Actuated Green, G (s)	54.6	50.8		51.8	49.4			14.0	14.0	14.0	14.0	14.0
Effective Green, g (s)	54.6	50.8		51.8	49.4			14.0	14.0	14.0	14.0	14.0
Actuated g/C Ratio	0.65	0.60		0.62	0.59			0.17	0.17	0.17	0.17	0.17
Clearance Time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	6.0		3.0	6.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	428	2103		490	2054			227	263	201	588	263
v/s Ratio Prot	c0.00	0.18		0.00	c0.23						0.01	
v/s Ratio Perm	0.06			0.04				c0.11	0.01	0.05		0.01
v/c Ratio	0.11	0.31		0.06	0.38			0.65	0.03	0.33	0.05	0.03
Uniform Delay, d1	5.6	8.1		6.3	9.3			32.8	29.4	31.0	29.5	29.4
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.4		0.1	0.5			6.6	0.1	1.0	0.0	0.1
Delay (s)	5.7	8.5		6.4	9.8			39.4	29.5	31.9	29.6	29.5
Level of Service	A	A		A	A			D	C	C	C	C
Approach Delay (s)		8.3			9.7			36.7			30.6	
Approach LOS		A			A			D			C	

Intersection Summary			
HCM 2000 Control Delay	13.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	84.2	Sum of lost time (s)	17.0
Intersection Capacity Utilization	52.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

LANE SUMMARY

Site: 2040 Ridge Road at Corporate Center Dr - AM

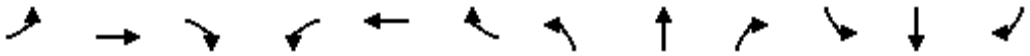
New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
SouthEast: Corporate Center Dr													
Lane 1[d]	255	0.0	955	0.268	100	6.5	LOS A	1.2	28.8	Full	1600	0.0	0.0
Approach	255	0.0		0.268		6.5	LOS A	1.2	28.8				
North: Ridge Rd													
Lane 1[d]	234	0.0	904	0.258	100	6.7	LOS A	1.1	27.0	Full	1600	0.0	0.0
Approach	234	0.0		0.258		6.7	LOS A	1.1	27.0				
West: Ridge Rd													
Lane 1[d]	223	0.0	1118	0.199	100	5.0	LOS A	0.8	20.9	Full	1600	0.0	0.0
Approach	223	0.0		0.199		5.0	LOS A	0.8	20.9				
Intersection	712	0.0		0.268		6.1	LOS A	1.2	28.8				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

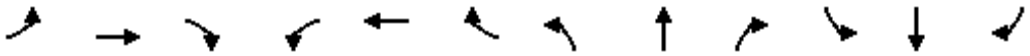
d Dominant lane on roundabout approach



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	90	335	175	85	340	15	285	100	25	15	250	200
Future Volume (vph)	90	335	175	85	340	15	285	100	25	15	250	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5			4.5			4.5	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.99			0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97			1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3517			1785			1752	
Flt Permitted	0.39	1.00	1.00	0.42	1.00			0.49			0.98	
Satd. Flow (perm)	723	3539	1583	786	3517			906			1726	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	364	190	92	370	16	310	109	27	16	272	217
RTOR Reduction (vph)	0	0	154	0	2	0	0	3	0	0	28	0
Lane Group Flow (vph)	98	364	36	92	384	0	0	443	0	0	477	0
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	20.7	15.1	15.1	20.5	15.0			46.2			46.2	
Effective Green, g (s)	20.7	15.1	15.1	20.5	15.0			46.2			46.2	
Actuated g/C Ratio	0.26	0.19	0.19	0.26	0.19			0.58			0.58	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5			4.5			4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	259	665	297	268	656			521			993	
v/s Ratio Prot	c0.03	0.10		0.02	c0.11							
v/s Ratio Perm	0.07		0.02	0.06				c0.49			0.28	
v/c Ratio	0.38	0.55	0.12	0.34	0.58			0.85			0.48	
Uniform Delay, d1	23.5	29.5	27.1	23.6	29.8			14.2			10.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.9	0.9	0.2	0.8	1.3			12.6			0.4	
Delay (s)	24.4	30.4	27.3	24.3	31.1			26.8			10.4	
Level of Service	C	C	C	C	C			C			B	
Approach Delay (s)		28.6			29.8			26.8			10.4	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	24.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	80.3	Sum of lost time (s)	13.5
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

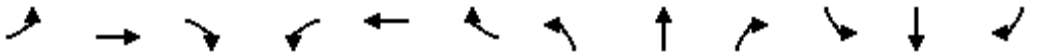
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	0	0	5	25	0	125	5	255	35	130	405	0
Future Volume (vph)	0	0	5	25	0	125	5	255	35	130	405	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	5	27	0	136	5	277	38	141	440	0

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	0	5	27	136	320	581
Volume Left (vph)	0	0	27	0	5	141
Volume Right (vph)	0	5	0	136	38	0
Hadj (s)	0.00	-0.67	0.53	-0.67	-0.03	0.08
Departure Headway (s)	7.1	6.4	7.2	6.0	5.1	4.9
Degree Utilization, x	0.00	0.01	0.05	0.23	0.46	0.80
Capacity (veh/h)	900	497	459	551	673	718
Control Delay (s)	8.9	8.3	9.5	9.6	12.4	24.4
Approach Delay (s)	8.3		9.6		12.4	24.4
Approach LOS	A		A		B	C

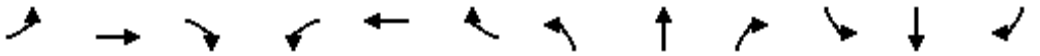
Intersection Summary				
Delay	18.4			
Level of Service	C			
Intersection Capacity Utilization	62.4%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	75	450	35	45	200	75	10	145	65	10	200	225
Future Volume (vph)	75	450	35	45	200	75	10	145	65	10	200	225
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor		0.95			0.95		1.00	1.00	1.00		1.00	1.00
Frt		0.99			0.96		1.00	1.00	0.85		1.00	0.85
Flt Protected		0.99			0.99		0.95	1.00	1.00		1.00	1.00
Satd. Flow (prot)		3483			3390		1770	1863	1583		1858	1583
Flt Permitted		0.85			0.83		0.51	1.00	1.00		0.98	1.00
Satd. Flow (perm)		2996			2844		954	1863	1583		1828	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	489	38	49	217	82	11	158	71	11	217	245
RTOR Reduction (vph)	0	5	0	0	30	0	0	0	56	0	0	193
Lane Group Flow (vph)	0	604	0	0	318	0	11	158	15	0	228	52
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4		4	8		8
Actuated Green, G (s)		40.2			40.2		13.5	13.5	13.5		13.5	13.5
Effective Green, g (s)		40.2			40.2		13.5	13.5	13.5		13.5	13.5
Actuated g/C Ratio		0.63			0.63		0.21	0.21	0.21		0.21	0.21
Clearance Time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)		5.0			5.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1890			1794		202	394	335		387	335
v/s Ratio Prot								0.08				
v/s Ratio Perm		c0.20			0.11		0.01		0.01		c0.12	0.03
v/c Ratio		0.32			0.18		0.05	0.40	0.04		0.59	0.15
Uniform Delay, d1		5.4			4.9		20.0	21.6	20.0		22.6	20.5
Progression Factor		1.00			1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2		0.4			0.1		0.1	0.7	0.1		2.3	0.2
Delay (s)		5.9			5.0		20.1	22.3	20.0		24.9	20.7
Level of Service		A			A		C	C	C		C	C
Approach Delay (s)		5.9			5.0			21.5			22.7	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	12.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	63.7	Sum of lost time (s)	10.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	1185	85	55	525	70	35	25	30	140	35	100
Future Volume (vph)	105	1185	85	55	525	70	35	25	30	140	35	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	0.98			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3504		1770	3477			1810	1583	1770	3539	1583
Flt Permitted	0.36	1.00		0.12	1.00			0.81	1.00	0.71	1.00	1.00
Satd. Flow (perm)	672	3504		231	3477			1502	1583	1331	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	1288	92	60	571	76	38	27	33	152	38	109
RTOR Reduction (vph)	0	3	0	0	8	0	0	0	27	0	0	90
Lane Group Flow (vph)	114	1377	0	60	639	0	0	65	6	152	38	19
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	1	6		5	2			8			4	
Permitted Phases	6			2			8		8	4		4
Actuated Green, G (s)	56.0	48.5		51.6	46.3			15.0	15.0	15.0	15.0	15.0
Effective Green, g (s)	56.0	48.5		51.6	46.3			15.0	15.0	15.0	15.0	15.0
Actuated g/C Ratio	0.65	0.57		0.60	0.54			0.17	0.17	0.17	0.17	0.17
Clearance Time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	6.0		3.0	6.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	534	1980		233	1876			262	276	232	618	276
v/s Ratio Prot	c0.02	c0.39		0.02	0.18						0.01	
v/s Ratio Perm	0.12			0.14				0.04	0.00	c0.11		0.01
v/c Ratio	0.21	0.70		0.26	0.34			0.25	0.02	0.66	0.06	0.07
Uniform Delay, d1	5.7	13.4		9.1	11.1			30.5	29.3	33.0	29.5	29.6
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	2.0		0.6	0.5			0.5	0.0	6.5	0.0	0.1
Delay (s)	5.9	15.4		9.7	11.6			31.0	29.3	39.5	29.6	29.7
Level of Service	A	B		A	B			C	C	D	C	C
Approach Delay (s)		14.7			11.5			30.5			34.7	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	16.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	85.8	Sum of lost time (s)	17.0
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

LANE SUMMARY

Site: 2040 Ridge Road at Corporate Center Dr - PM

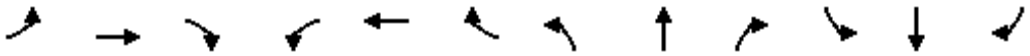
New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
SouthEast: Corporate Center Dr													
Lane 1[d]	207	0.0	929	0.222	100	6.1	LOS A	0.9	22.6	Full	1600	0.0	0.0
Approach	207	0.0		0.222		6.1	LOS A	0.9	22.6				
North: Ridge Rd													
Lane 1[d]	359	0.0	924	0.388	100	8.3	LOS A	1.9	47.3	Full	1600	0.0	0.0
Approach	359	0.0		0.388		8.3	LOS A	1.9	47.3				
West: Ridge Rd													
Lane 1[d]	304	0.0	1064	0.286	100	6.2	LOS A	1.3	32.9	Full	1600	0.0	0.0
Approach	304	0.0		0.286		6.2	LOS A	1.3	32.9				
Intersection	870	0.0		0.388		7.0	LOS A	1.9	47.3				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

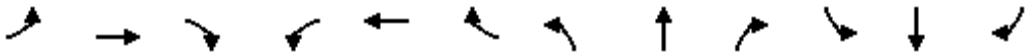
d Dominant lane on roundabout approach



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	220	455	55	580	15	435	150	35	15	175	265
Future Volume (vph)	115	220	455	55	580	15	435	150	35	15	175	265
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5			4.5			4.5	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00			1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.99			0.92	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97			1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3526			1786			1713	
Flt Permitted	0.17	1.00	1.00	0.56	1.00			0.50			0.97	
Satd. Flow (perm)	317	3539	1583	1037	3526			926			1671	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	125	239	495	60	630	16	473	163	38	16	190	288
RTOR Reduction (vph)	0	0	399	0	2	0	0	2	0	0	42	0
Lane Group Flow (vph)	125	239	96	60	644	0	0	672	0	0	452	0
Turn Type	pm+pt	NA	Perm	pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	29.0	23.5	23.5	26.8	22.4			79.5			79.5	
Effective Green, g (s)	29.0	23.5	23.5	26.8	22.4			79.5			79.5	
Actuated g/C Ratio	0.24	0.19	0.19	0.22	0.19			0.66			0.66	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5			4.5			4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	142	687	307	256	653			608			1098	
v/s Ratio Prot	c0.04	0.07		0.01	c0.18							
v/s Ratio Perm	0.17		0.06	0.04				c0.73			0.27	
v/c Ratio	0.88	0.35	0.31	0.23	0.99			1.11			0.41	
Uniform Delay, d1	42.6	42.1	41.8	37.9	49.1			20.7			9.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2	42.2	0.3	0.6	0.5	31.6			68.9			0.3	
Delay (s)	84.9	42.4	42.4	38.4	80.7			89.6			10.0	
Level of Service	F	D	D	D	F			F			A	
Approach Delay (s)		48.6			77.1			89.6			10.0	
Approach LOS		D			E			F			A	

Intersection Summary			
HCM 2000 Control Delay	59.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	120.9	Sum of lost time (s)	13.5
Intersection Capacity Utilization	98.3%	ICU Level of Service	F
Analysis Period (min)	15		

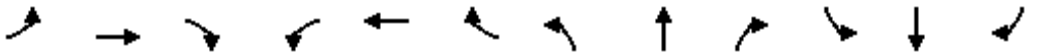
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	5	0	0	20	0	165	0	450	35	130	525	0
Future Volume (vph)	5	0	0	20	0	165	0	450	35	130	525	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	0	0	22	0	179	0	489	38	141	571	0

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	5	0	22	179	527	712
Volume Left (vph)	5	0	22	0	0	141
Volume Right (vph)	0	0	0	179	38	0
Hadj (s)	0.53	0.00	0.53	-0.67	-0.01	0.07
Departure Headway (s)	8.5	8.0	7.9	6.7	5.5	5.5
Degree Utilization, x	0.01	0.00	0.05	0.33	0.81	1.00
Capacity (veh/h)	392	900	433	514	641	712
Control Delay (s)	10.4	9.8	10.1	11.8	27.8	58.2
Approach Delay (s)	10.4		11.6		27.8	58.2
Approach LOS	B		B		D	F

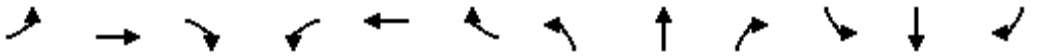
Intersection Summary				
Delay	40.5			
Level of Service	E			
Intersection Capacity Utilization	80.8%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	165	275	20	55	460	210	40	110	60	10	365	170
Future Volume (vph)	165	275	20	55	460	210	40	110	60	10	365	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor		0.95			0.95		1.00	1.00	1.00		1.00	1.00
Frt		0.99			0.96		1.00	1.00	0.85		1.00	0.85
Flt Protected		0.98			1.00		0.95	1.00	1.00		1.00	1.00
Satd. Flow (prot)		3454			3373		1770	1863	1583		1860	1583
Flt Permitted		0.57			0.88		0.27	1.00	1.00		0.99	1.00
Satd. Flow (perm)		2020			2973		501	1863	1583		1848	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	179	299	22	60	500	228	43	120	65	11	397	185
RTOR Reduction (vph)	0	4	0	0	53	0	0	0	46	0	0	132
Lane Group Flow (vph)	0	496	0	0	735	0	43	120	19	0	408	53
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4		4	8		8
Actuated Green, G (s)		40.2			40.2		20.0	20.0	20.0		20.0	20.0
Effective Green, g (s)		40.2			40.2		20.0	20.0	20.0		20.0	20.0
Actuated g/C Ratio		0.57			0.57		0.28	0.28	0.28		0.28	0.28
Clearance Time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)		5.0			5.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1156			1702		142	530	450		526	450
v/s Ratio Prot								0.06				
v/s Ratio Perm		0.25			c0.25		0.09		0.01		c0.22	0.03
v/c Ratio		0.43			0.43		0.30	0.23	0.04		0.78	0.12
Uniform Delay, d1		8.5			8.5		19.6	19.2	18.2		23.0	18.6
Progression Factor		1.00			1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2		1.2			0.4		1.2	0.2	0.0		7.1	0.1
Delay (s)		9.7			8.9		20.9	19.4	18.2		30.1	18.7
Level of Service		A			A		C	B	B		C	B
Approach Delay (s)		9.7			8.9			19.3			26.5	
Approach LOS		A			A			B			C	

Intersection Summary			
HCM 2000 Control Delay	15.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	70.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		

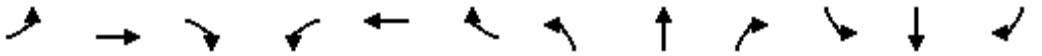
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	645	65	30	820	100	125	25	55	185	40	215
Future Volume (vph)	85	645	65	30	820	100	125	25	55	185	40	215
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	0.98			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3490		1770	3481			1788	1583	1770	3539	1583
Flt Permitted	0.20	1.00		0.33	1.00			0.73	1.00	0.62	1.00	1.00
Satd. Flow (perm)	380	3490		615	3481			1360	1583	1162	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	701	71	33	891	109	136	27	60	201	43	234
RTOR Reduction (vph)	0	5	0	0	7	0	0	0	46	0	0	181
Lane Group Flow (vph)	92	767	0	33	993	0	0	163	14	201	43	53
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	1	6		5	2			8			4	
Permitted Phases	6			2			8		8	4		4
Actuated Green, G (s)	54.8	48.9		50.4	46.7			20.4	20.4	20.4	20.4	20.4
Effective Green, g (s)	54.8	48.9		50.4	46.7			20.4	20.4	20.4	20.4	20.4
Actuated g/C Ratio	0.61	0.54		0.56	0.52			0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	6.0		3.0	6.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	322	1896		391	1806			308	358	263	802	358
v/s Ratio Prot	c0.02	0.22		0.00	c0.29						0.01	
v/s Ratio Perm	0.15			0.04				0.12	0.01	c0.17		0.03
v/c Ratio	0.29	0.40		0.08	0.55			0.53	0.04	0.76	0.05	0.15
Uniform Delay, d1	8.6	12.0		9.0	14.6			30.6	27.1	32.6	27.2	27.8
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.6		0.1	1.2			1.6	0.0	12.4	0.0	0.2
Delay (s)	9.1	12.7		9.1	15.8			32.2	27.2	44.9	27.3	28.0
Level of Service	A	B		A	B			C	C	D	C	C
Approach Delay (s)		12.3			15.6			30.9			35.1	
Approach LOS		B			B			C			D	

Intersection Summary			
HCM 2000 Control Delay	19.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	62.4%	ICU Level of Service	B
Analysis Period (min)	15		

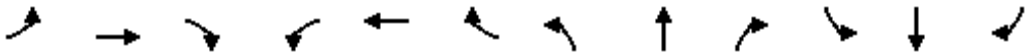
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	90	335	175	85	340	15	285	100	25	15	250	200
Future Volume (vph)	90	335	175	85	340	15	285	100	25	15	250	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5			4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00			1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.97			1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3517		1770	1807			1858	1583
Flt Permitted	0.39	1.00	1.00	0.44	1.00		0.30	1.00			0.98	1.00
Satd. Flow (perm)	725	3539	1583	814	3517		564	1807			1828	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	364	190	92	370	16	310	109	27	16	272	217
RTOR Reduction (vph)	0	0	154	0	2	0	0	8	0	0	0	165
Lane Group Flow (vph)	98	364	36	92	384	0	310	128	0	0	288	52
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA		Perm	NA	Perm
Protected Phases	7	4		3	8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	21.6	14.8	14.8	21.0	14.5		42.5	42.5			18.7	18.7
Effective Green, g (s)	21.6	14.8	14.8	21.0	14.5		42.5	42.5			18.7	18.7
Actuated g/C Ratio	0.28	0.19	0.19	0.27	0.19		0.55	0.55			0.24	0.24
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5			4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	294	677	303	301	659		611	993			442	382
v/s Ratio Prot	c0.03	0.10		0.03	c0.11		c0.13	0.07				
v/s Ratio Perm	0.06		0.02	0.06			0.15				c0.16	0.03
v/c Ratio	0.33	0.54	0.12	0.31	0.58		0.51	0.13			0.65	0.14
Uniform Delay, d1	21.3	28.2	25.9	21.7	28.6		10.6	8.4			26.4	23.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	0.7	0.8	0.2	0.6	1.3		0.7	0.1			3.4	0.2
Delay (s)	22.0	29.0	26.0	22.3	30.0		11.3	8.5			29.8	23.1
Level of Service	C	C	C	C	C		B	A			C	C
Approach Delay (s)		27.1			28.5			10.4			26.9	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	23.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	77.3	Sum of lost time (s)	18.0
Intersection Capacity Utilization	59.6%	ICU Level of Service	B
Analysis Period (min)	15		

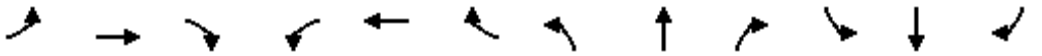
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	5	25	0	125	5	255	35	130	405	0
Future Volume (Veh/h)	0	0	5	25	0	125	5	255	35	130	405	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	5	27	0	136	5	277	38	141	440	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											1003	
pX, platoon unblocked	0.89	0.89	0.89	0.89	0.89		0.89					
vC, conflicting volume	1164	1047	440	1033	1028	296	440			315		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1122	990	307	975	969	296	307			315		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	99	85	100	82	100			89		
cM capacity (veh/h)	121	193	651	185	199	743	1114			1245		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	0	5	27	136	320	581
Volume Left	0	0	27	0	5	141
Volume Right	0	5	0	136	38	0
cSH	1700	651	185	743	1114	1245
Volume to Capacity	0.00	0.01	0.15	0.18	0.00	0.11
Queue Length 95th (ft)	0	1	12	17	0	10
Control Delay (s)	0.0	10.6	27.7	10.9	0.2	3.0
Lane LOS	A	B	D	B	A	A
Approach Delay (s)	10.6		13.7		0.2	3.0
Approach LOS	B		B			

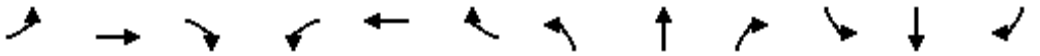
Intersection Summary				
Average Delay	3.8			
Intersection Capacity Utilization	62.4%	ICU Level of Service		B
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	75	450	35	45	200	75	10	145	65	10	200	225
Future Volume (vph)	75	450	35	45	200	75	10	145	65	10	200	225
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor		0.95			0.95		1.00	1.00	1.00		1.00	1.00
Frt		0.99			0.96		1.00	1.00	0.85		1.00	0.85
Flt Protected		0.99			0.99		0.95	1.00	1.00		1.00	1.00
Satd. Flow (prot)		3483			3390		1770	1863	1583		1858	1583
Flt Permitted		0.85			0.83		0.51	1.00	1.00		0.98	1.00
Satd. Flow (perm)		2996			2844		954	1863	1583		1828	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	489	38	49	217	82	11	158	71	11	217	245
RTOR Reduction (vph)	0	5	0	0	30	0	0	0	56	0	0	193
Lane Group Flow (vph)	0	604	0	0	318	0	11	158	15	0	228	52
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4		4	8		8
Actuated Green, G (s)		40.2			40.2		13.5	13.5	13.5		13.5	13.5
Effective Green, g (s)		40.2			40.2		13.5	13.5	13.5		13.5	13.5
Actuated g/C Ratio		0.63			0.63		0.21	0.21	0.21		0.21	0.21
Clearance Time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)		5.0			5.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1890			1794		202	394	335		387	335
v/s Ratio Prot								0.08				
v/s Ratio Perm		c0.20			0.11		0.01		0.01		c0.12	0.03
v/c Ratio		0.32			0.18		0.05	0.40	0.04		0.59	0.15
Uniform Delay, d1		5.4			4.9		20.0	21.6	20.0		22.6	20.5
Progression Factor		1.00			1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2		0.4			0.1		0.1	0.7	0.1		2.3	0.2
Delay (s)		5.9			5.0		20.1	22.3	20.0		24.9	20.7
Level of Service		A			A		C	C	C		C	C
Approach Delay (s)		5.9			5.0			21.5			22.7	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	12.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	63.7	Sum of lost time (s)	10.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		

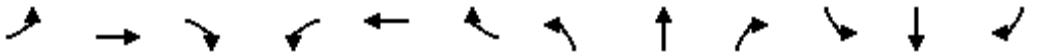
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	1185	85	55	525	70	35	25	30	140	35	100
Future Volume (vph)	105	1185	85	55	525	70	35	25	30	140	35	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	0.98			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3504		1770	3477			1810	1583	1770	3539	1583
Flt Permitted	0.36	1.00		0.12	1.00			0.81	1.00	0.71	1.00	1.00
Satd. Flow (perm)	672	3504		231	3477			1502	1583	1331	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	1288	92	60	571	76	38	27	33	152	38	109
RTOR Reduction (vph)	0	3	0	0	8	0	0	0	27	0	0	90
Lane Group Flow (vph)	114	1377	0	60	639	0	0	65	6	152	38	19
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	1	6		5	2			8			4	
Permitted Phases	6			2			8		8	4		4
Actuated Green, G (s)	56.0	48.5		51.6	46.3			15.0	15.0	15.0	15.0	15.0
Effective Green, g (s)	56.0	48.5		51.6	46.3			15.0	15.0	15.0	15.0	15.0
Actuated g/C Ratio	0.65	0.57		0.60	0.54			0.17	0.17	0.17	0.17	0.17
Clearance Time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	6.0		3.0	6.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	534	1980		233	1876			262	276	232	618	276
v/s Ratio Prot	c0.02	c0.39		0.02	0.18						0.01	
v/s Ratio Perm	0.12			0.14				0.04	0.00	c0.11		0.01
v/c Ratio	0.21	0.70		0.26	0.34			0.25	0.02	0.66	0.06	0.07
Uniform Delay, d1	5.7	13.4		9.1	11.1			30.5	29.3	33.0	29.5	29.6
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	2.0		0.6	0.5			0.5	0.0	6.5	0.0	0.1
Delay (s)	5.9	15.4		9.7	11.6			31.0	29.3	39.5	29.6	29.7
Level of Service	A	B		A	B			C	C	D	C	C
Approach Delay (s)		14.7			11.5			30.5			34.7	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	16.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	85.8	Sum of lost time (s)	17.0
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		

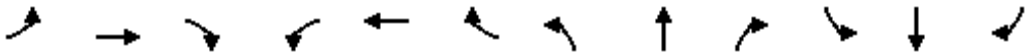
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	220	455	55	580	15	435	150	35	15	175	265
Future Volume (vph)	115	220	455	55	580	15	435	150	35	15	175	265
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5			4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00			1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.97			1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3526		1770	1810			1856	1583
Flt Permitted	0.16	1.00	1.00	0.60	1.00		0.32	1.00			0.97	1.00
Satd. Flow (perm)	303	3539	1583	1124	3526		595	1810			1799	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	125	239	495	60	630	16	473	163	38	16	190	288
RTOR Reduction (vph)	0	0	340	0	2	0	0	7	0	0	0	188
Lane Group Flow (vph)	125	239	155	60	644	0	473	194	0	0	206	100
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA		Perm	NA	Perm
Protected Phases	7	4		3	8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	39.2	30.9	30.9	28.1	24.3		50.2	50.2			16.9	16.9
Effective Green, g (s)	39.2	30.9	30.9	28.1	24.3		50.2	50.2			16.9	16.9
Actuated g/C Ratio	0.40	0.31	0.31	0.29	0.25		0.51	0.51			0.17	0.17
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5			4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	275	1111	497	345	870		647	923			308	271
v/s Ratio Prot	c0.05	0.07		0.01	c0.18		c0.21	0.11				
v/s Ratio Perm	0.13		0.10	0.04			c0.16				0.11	0.06
v/c Ratio	0.45	0.22	0.31	0.17	0.74		0.73	0.21			0.67	0.37
Uniform Delay, d1	21.0	24.8	25.7	26.0	34.1		17.1	13.2			38.1	36.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	1.2	0.1	0.4	0.2	3.4		4.3	0.1			5.4	0.9
Delay (s)	22.2	24.9	26.0	26.2	37.6		21.3	13.3			43.6	36.9
Level of Service	C	C	C	C	D		C	B			D	D
Approach Delay (s)		25.2			36.6			18.9			39.7	
Approach LOS		C			D			B			D	

Intersection Summary			
HCM 2000 Control Delay	29.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	98.4	Sum of lost time (s)	18.0
Intersection Capacity Utilization	72.0%	ICU Level of Service	C
Analysis Period (min)	15		

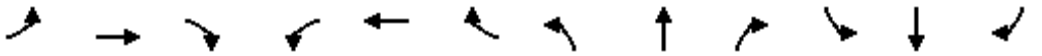
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	0	0	20	0	165	0	450	35	130	525	0
Future Volume (Veh/h)	5	0	0	20	0	165	0	450	35	130	525	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	0	0	22	0	179	0	489	38	141	571	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											1003	
pX, platoon unblocked	0.93	0.93	0.93	0.93	0.93		0.93					
vC, conflicting volume	1540	1380	571	1361	1361	508	571			527		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1543	1372	505	1351	1351	508	505			527		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	91	100	100	79	100	68	100			86		
cM capacity (veh/h)	54	118	529	107	121	565	989			1040		

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	5	0	22	179	527	712
Volume Left	5	0	22	0	0	141
Volume Right	0	0	0	179	38	0
cSH	54	1700	107	565	989	1040
Volume to Capacity	0.09	0.00	0.21	0.32	0.00	0.14
Queue Length 95th (ft)	7	0	18	34	0	12
Control Delay (s)	79.0	0.0	47.4	14.3	0.0	3.3
Lane LOS	F	A	E	B		A
Approach Delay (s)	79.0		17.9		0.0	3.3
Approach LOS	F		C			

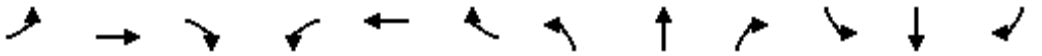
Intersection Summary				
Average Delay	4.4			
Intersection Capacity Utilization	80.8%	ICU Level of Service		D
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	165	275	20	55	460	210	40	110	60	10	365	170
Future Volume (vph)	165	275	20	55	460	210	40	110	60	10	365	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor		0.95			0.95		1.00	1.00	1.00		1.00	1.00
Frt		0.99			0.96		1.00	1.00	0.85		1.00	0.85
Flt Protected		0.98			1.00		0.95	1.00	1.00		1.00	1.00
Satd. Flow (prot)		3454			3373		1770	1863	1583		1860	1583
Flt Permitted		0.57			0.88		0.27	1.00	1.00		0.99	1.00
Satd. Flow (perm)		2020			2973		501	1863	1583		1848	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	179	299	22	60	500	228	43	120	65	11	397	185
RTOR Reduction (vph)	0	4	0	0	53	0	0	0	46	0	0	132
Lane Group Flow (vph)	0	496	0	0	735	0	43	120	19	0	408	53
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4		4	8		8
Actuated Green, G (s)		40.2			40.2		20.0	20.0	20.0		20.0	20.0
Effective Green, g (s)		40.2			40.2		20.0	20.0	20.0		20.0	20.0
Actuated g/C Ratio		0.57			0.57		0.28	0.28	0.28		0.28	0.28
Clearance Time (s)		5.0			5.0		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)		5.0			5.0		3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1156			1702		142	530	450		526	450
v/s Ratio Prot								0.06				
v/s Ratio Perm		0.25			c0.25		0.09		0.01		c0.22	0.03
v/c Ratio		0.43			0.43		0.30	0.23	0.04		0.78	0.12
Uniform Delay, d1		8.5			8.5		19.6	19.2	18.2		23.0	18.6
Progression Factor		1.00			1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2		1.2			0.4		1.2	0.2	0.0		7.1	0.1
Delay (s)		9.7			8.9		20.9	19.4	18.2		30.1	18.7
Level of Service		A			A		C	B	B		C	B
Approach Delay (s)		9.7			8.9			19.3			26.5	
Approach LOS		A			A			B			C	

Intersection Summary			
HCM 2000 Control Delay	15.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	70.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	645	65	30	820	100	125	25	55	185	40	215
Future Volume (vph)	85	645	65	30	820	100	125	25	55	185	40	215
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	0.98			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3490		1770	3481			1788	1583	1770	3539	1583
Flt Permitted	0.20	1.00		0.33	1.00			0.73	1.00	0.62	1.00	1.00
Satd. Flow (perm)	380	3490		615	3481			1360	1583	1162	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	701	71	33	891	109	136	27	60	201	43	234
RTOR Reduction (vph)	0	5	0	0	7	0	0	0	46	0	0	181
Lane Group Flow (vph)	92	767	0	33	993	0	0	163	14	201	43	53
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	1	6		5	2			8			4	
Permitted Phases	6			2			8		8	4		4
Actuated Green, G (s)	54.8	48.9		50.4	46.7			20.4	20.4	20.4	20.4	20.4
Effective Green, g (s)	54.8	48.9		50.4	46.7			20.4	20.4	20.4	20.4	20.4
Actuated g/C Ratio	0.61	0.54		0.56	0.52			0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	5.0	6.0		5.0	6.0			6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	6.0		3.0	6.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	322	1896		391	1806			308	358	263	802	358
v/s Ratio Prot	c0.02	0.22		0.00	c0.29						0.01	
v/s Ratio Perm	0.15			0.04				0.12	0.01	c0.17		0.03
v/c Ratio	0.29	0.40		0.08	0.55			0.53	0.04	0.76	0.05	0.15
Uniform Delay, d1	8.6	12.0		9.0	14.6			30.6	27.1	32.6	27.2	27.8
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.6		0.1	1.2			1.6	0.0	12.4	0.0	0.2
Delay (s)	9.1	12.7		9.1	15.8			32.2	27.2	44.9	27.3	28.0
Level of Service	A	B		A	B			C	C	D	C	C
Approach Delay (s)		12.3			15.6			30.9			35.1	
Approach LOS		B			B			C			D	

Intersection Summary			
HCM 2000 Control Delay	19.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	62.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Appendix D:

2040 No build and Recommended Design Queuing Summary Tables

Appendix D:

2040 No build and Recommended Design Queuing Summary Tables

Intersection: 1: Ridge Rd & MD 758 (Corporate Center Dr)

Movement	WB	SB	NE
Directions Served	LR	LR	LR
Maximum Queue (ft)	74	62	54
Average Queue (ft)	22	22	2
95th Queue (ft)	57	55	20
Link Distance (ft)	646	653	722
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Ridge Rd & Hanover Rd

Movement	EB	EB	EB	EB	WB	WB	WB	NB	SB
Directions Served	L	T	T	R	L	T	TR	LTR	LTR
Maximum Queue (ft)	131	190	170	67	109	190	156	258	252
Average Queue (ft)	41	98	53	16	31	101	60	158	124
95th Queue (ft)	99	168	133	45	78	179	146	242	208
Link Distance (ft)		681	681			705	705	894	1138
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	250			250	250				
Storage Blk Time (%)									
Queuing Penalty (veh)									

Intersection: 3: Ridge Rd & Stoney Run Rd

Movement	EB	WB	WB	NB	SB
Directions Served	TR	L	TR	LTR	LTR
Maximum Queue (ft)	30	39	73	128	132
Average Queue (ft)	5	15	34	59	72
95th Queue (ft)	24	36	56	96	109
Link Distance (ft)	333		560	2794	894
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)		280			
Storage Blk Time (%)	0				
Queuing Penalty (veh)	0				

Intersection: 4: Ridge Rd & New Ridge Rd

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	T	R	LT	R
Maximum Queue (ft)	160	128	106	61	26	114	27	156	113
Average Queue (ft)	75	33	48	23	3	36	2	75	44
95th Queue (ft)	136	84	88	51	14	86	13	131	82
Link Distance (ft)	686	686	617	617		1179	1179	971	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)					60				170
Storage Blk Time (%)					0	3		0	
Queuing Penalty (veh)					0	0		0	

Intersection: 5: Ridge Rd & MD 176 (Dorsey Rd)

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	LT	R	L	T	T
Maximum Queue (ft)	174	275	246	69	125	100	82	46	156	33	39
Average Queue (ft)	43	127	102	27	65	28	37	17	76	10	11
95th Queue (ft)	100	223	195	58	115	72	72	41	134	33	35
Link Distance (ft)		581	581		792	792	625	625		1179	1179
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	175			250					330		
Storage Blk Time (%)	0	2									
Queuing Penalty (veh)	0	2									

Network Summary

Network wide Queuing Penalty: 2

Intersection: 1: Ridge Rd & MD 758 (Corporate Center Dr)

Movement	WB	SB	NE
Directions Served	LR	LR	LR
Maximum Queue (ft)	55	112	69
Average Queue (ft)	16	35	10
95th Queue (ft)	46	81	42
Link Distance (ft)	646	653	722
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Ridge Rd & Hanover Rd

Movement	EB	EB	EB	EB	WB	WB	WB	NB	SB
Directions Served	L	T	T	R	L	T	TR	LTR	LTR
Maximum Queue (ft)	188	191	166	216	274	378	346	674	318
Average Queue (ft)	88	91	39	80	49	238	200	370	149
95th Queue (ft)	205	198	132	174	170	361	320	674	262
Link Distance (ft)		681	681			705	705	894	1138
Upstream Blk Time (%)								0	
Queuing Penalty (veh)								1	
Storage Bay Dist (ft)	250			250	250				
Storage Blk Time (%)	5			0	0	11			
Queuing Penalty (veh)	6			0	0	6			

Intersection: 3: Ridge Rd & Stoney Run Rd

Movement	EB	WB	WB	NB	SB
Directions Served	L	L	TR	LTR	LTR
Maximum Queue (ft)	28	39	88	244	238
Average Queue (ft)	5	14	45	116	108
95th Queue (ft)	22	36	75	199	190
Link Distance (ft)			560	2794	894
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	50	280			
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 4: Ridge Rd & New Ridge Rd

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	T	R	LT	R
Maximum Queue (ft)	282	243	173	164	63	113	18	287	194
Average Queue (ft)	139	67	98	74	15	24	2	152	63
95th Queue (ft)	236	179	153	134	44	70	10	243	167
Link Distance (ft)	686	686	617	617		1179	1179	971	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)					60				170
Storage Blk Time (%)					1	2		6	0
Queuing Penalty (veh)					1	1		10	0

Intersection: 5: Ridge Rd & MD 176 (Dorsey Rd)

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	LT	R	L	T	T	R
Maximum Queue (ft)	98	179	132	48	224	182	179	52	188	50	56	100
Average Queue (ft)	39	86	52	15	113	73	84	22	101	14	14	7
95th Queue (ft)	77	145	102	37	194	155	144	45	167	41	44	53
Link Distance (ft)		581	581		792	792	625	625		1179	1179	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	175			250					330			250
Storage Blk Time (%)		0			0							
Queuing Penalty (veh)		0			0							

Network Summary

Network wide Queuing Penalty: 25

Intersection: 1: Ridge Rd & MD 758 (Corporate Center Dr)

Movement	WB	SB	NE
Directions Served	LR	LR	LR
Maximum Queue (ft)	66	59	18
Average Queue (ft)	18	21	1
95th Queue (ft)	53	52	9
Link Distance (ft)	646	653	722
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Ridge Rd & Hanover Rd

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	TR	L	TR	LT	R
Maximum Queue (ft)	85	156	126	101	107	175	150	197	149	247	170
Average Queue (ft)	25	79	27	14	30	80	40	102	39	115	54
95th Queue (ft)	59	143	93	53	75	147	109	173	101	200	109
Link Distance (ft)		660	660			699	699		891	1129	
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	250			250	250			250			250
Storage Blk Time (%)								0		0	
Queuing Penalty (veh)								0		0	

Intersection: 3: Ridge Rd & Stoney Run Rd

Movement	EB	WB	WB	NB	SB
Directions Served	TR	L	TR	LTR	LTR
Maximum Queue (ft)	30	56	68	38	156
Average Queue (ft)	5	19	35	2	43
95th Queue (ft)	22	48	55	21	111
Link Distance (ft)	326		554	2793	891
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)		280			
Storage Blk Time (%)	0				
Queuing Penalty (veh)	0				

Intersection: 4: Ridge Rd & New Ridge Rd

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	T	R	LT	R
Maximum Queue (ft)	141	102	142	80	38	116	16	210	182
Average Queue (ft)	71	30	56	25	4	35	1	86	55
95th Queue (ft)	125	73	108	59	19	85	9	158	116
Link Distance (ft)	686	686	617	617		1179	1179	971	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)					60				170
Storage Blk Time (%)						3		1	0
Queuing Penalty (veh)						0		1	0

Intersection: 5: Ridge Rd & MD 176 (Dorsey Rd)

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	LT	R	L	T	T	R
Maximum Queue (ft)	153	301	264	75	166	129	89	56	166	38	56	18
Average Queue (ft)	42	135	105	26	65	29	38	16	84	10	15	1
95th Queue (ft)	96	238	209	58	126	80	76	40	144	33	43	13
Link Distance (ft)		581	581		792	792	625	625		1179	1179	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	175			250					330			250
Storage Blk Time (%)		2										
Queuing Penalty (veh)		2										

Network Summary

Network wide Queuing Penalty: 4

Intersection: 1: Ridge Rd & MD 758 (Corporate Center Dr)

Movement	WB	SB	NE
Directions Served	LR	LR	LR
Maximum Queue (ft)	61	98	68
Average Queue (ft)	17	31	12
95th Queue (ft)	48	72	47
Link Distance (ft)	646	653	722
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Ridge Rd & Hanover Rd

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	TR	L	TR	LT	R
Maximum Queue (ft)	128	141	90	167	150	292	244	274	397	233	185
Average Queue (ft)	42	55	11	62	23	163	124	184	95	114	76
95th Queue (ft)	94	110	53	135	81	248	216	287	247	200	135
Link Distance (ft)		660	660			699	699		891	1129	
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	250			250	250			250			250
Storage Blk Time (%)					0	1		4		0	0
Queuing Penalty (veh)					0	0		7		1	0

Intersection: 3: Ridge Rd & Stoney Run Rd

Movement	EB	WB	WB	NB	SB
Directions Served	L	L	TR	LTR	LTR
Maximum Queue (ft)	31	56	93	4	215
Average Queue (ft)	4	16	47	0	75
95th Queue (ft)	20	43	79	2	173
Link Distance (ft)			554	2793	891
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	50	280			
Storage Blk Time (%)	0				
Queuing Penalty (veh)	0				

Intersection: 4: Ridge Rd & New Ridge Rd

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	L	T	R	LT	R
Maximum Queue (ft)	284	255	168	153	60	112	22	362	195
Average Queue (ft)	142	76	95	76	12	30	1	169	75
95th Queue (ft)	254	197	152	137	41	77	11	304	192
Link Distance (ft)	686	686	617	617		1179	1179	971	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)					60				170
Storage Blk Time (%)					1	2		9	0
Queuing Penalty (veh)					1	1		15	0

Intersection: 5: Ridge Rd & MD 176 (Dorsey Rd)

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	LT	R	L	T	T	R
Maximum Queue (ft)	99	182	166	57	253	201	215	68	221	38	44	136
Average Queue (ft)	40	86	56	16	122	78	86	21	106	12	15	12
95th Queue (ft)	71	149	118	42	211	166	151	47	186	36	43	68
Link Distance (ft)		581	581		792	792	625	625		1179	1179	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	175			250					330			250
Storage Blk Time (%)		0			0							
Queuing Penalty (veh)		0			0							

Network Summary

Network wide Queuing Penalty: 25

Appendix F:

Cost Estimate Details

MD 713 (RIDGE ROAD) - NORTH CORRIDOR

ITEM	CODE		UNIT	PRICE	QUANTITY	AMOUNT
		Category 1 - Preliminary				
		35% of Categories 2, 4, 5, 6	CATEGORY TOTAL			$1,052,258
		Category 2 - Grading				
201	201030	Class 1 Excavation	CY	$40.00	8,119	$324,751
202	210025	Removal of existing pavement	CY	$50.00	0	$0
			CATEGORY TOTAL			$324,751
		Category 3 - Drainage				
		15% of Categories 2, 4, 5, 6	CATEGORY TOTAL			$450,968
		Category 4 - Structures				
			CATEGORY TOTAL			$0
		Category 5 - Paving				
501	535100	Milling asphalt pavement 0 inch to 2 inch	SY	$1.50	33,943	$50,915
502	585405	5 inch white reflective thermoplastic pavement markings	LF	$1.50	21,413	$32,120
503	585407	5 inch yellow reflective thermoplastic pavement markings	LF	$1.50	22,842	$34,263
504	585408	10 inch white reflective thermoplastic pavement markings	LF	$1.75	0	$0
505	585410	10 inch yellow reflective thermoplastic pavement markings	LF	$1.75	0	$0
506	585412	12 inch white reflective thermoplastic pavement markings	LF	$2.00	953	$1,906
507	585424	24 inch white reflective thermoplastic pavement markings	LF	$7.00	170	$1,190
508	585627	Preformed thermoplastic pavement marking legend and arrows	SF	$25.00	1,110	$27,755
509	504530	2 inch superpave asphalt mix for surface	TON	$80.00	5,703	$456,240
510	504560	3 inch superpave asphalt mix for base	TON	$80.00	2,650	$212,000
511	520111	4 inch graded aggregate base course	SY	$6.00	36,535	$219,207
			CATEGORY TOTAL			$1,035,595
		Category 6 - Shoulders				
601	600000	ADA Ramps (2 ramp set)	EA	$2,500.00	53	$132,500
602	634300	Type A curb and gutter - 12 inch gutter pan 8 inch depth	LF	$35.00	23,601	$826,035
603	655105	5 inch concrete sidewalk	SF	$7.00	117,153	$820,071
			CATEGORY TOTAL			$1,646,106
		Category 7 - Landscaping				
		10% of Categories 2, 4, 5, 6	CATEGORY TOTAL			$300,645
		Category 8 - Traffic				
801	800000	Traffic signal - T-intersection	EA	$200,000.00	0	$0
802	800000	Traffic signal - Full-intersection	EA	$250,000.00	0	$0
803	800000	Relocate roadway utility pole	EA	$3,000.00	13	$39,000
804	800000	Relocate roadway lighting structure	EA	$2,000.00	100	$200,000
805	800000	Relocate traffic signal pole and mast arm	EA	$15,000.00	3	$45,000
806	800000	Relocate pedestrian signal pole	EA	$1,200.00	1	$1,200
807	800000	Relocate fire hydrant	EA	$5,000.00	13	$65,000
808	801130	Square perforated tubular steel sign post	EA	$100.00	17	$1,700
809	801135	Square perforated tubular steel anchor bases	EA	$100.00	17	$1,700
810	813023	Relocate existing ground mounted signs	SF	$35.00	0	$0
811	801605	Sheet Aluminum Signs	SF	$50.00	75	$3,750
			CATEGORY TOTAL			$357,350
					SUB-TOTAL	$5,167,674
				Contingency	25%	$1,291,919
					TOTAL	$6,459,593

Construction Total	$6,460,000
Maintenance of Traffic	$323,000
Right of Way / Easements	$1,463,193
Total Sum	**$8,246,193**