A legacy of **experience.** A reputation for **excellence.**

5500 New Albany Road
Columbus, Ohio 43054
Phone: 614.775.4500
Fax: 614.775.4800
Toll Free: 1-888-775-EMHT

emht.com

2014-1763

BALLANTRAE WOODS TRAFFIC IMPACT STUDY

Kass Corporation

May 20, 2015

Engineers | Surveyors | Planners | Scientists

Traffic Study

For

Ballantrae Woods

on Liggett Tract

Prepared For:
Kass Corporation
7899 Columbia Road
Pataskala, Ohio 43062

Prepared By:
EMH&T
5500 New Albany Road
Columbus, Ohio 43054
Phone: 614-775-4500
Fax: 614-775-4800

May 20, 2015

The traffic engineering data, analysis, findings, and recommendations contained herein and originally produced by EMH&T have been prepared in accordance with accepted Engineering practice and represent anticipated future conditions to the best of our knowledge and belief.

Douglas A. Bender, PE, PTOE — Date 5/20/15
For EMH&T

© EMH&T, 2015
All Rights Reserved

TABLE OF CONTENTS

1.0 INTRODUCTION 3
2.0 EXISTING CONDITIONS 3
3.0 DATA COLLECTED 3
4.0 STUDY PROCEDURES 4
4.1 Traffic Volume Projections 4
4.2 Trip Generation 5
4.3 Trip Distribution 5
5.0 FINDINGS OF ANALYSES 11
5.1 Turn Lane Warrants/Storage Requirements 11
5.2 Signal Warrant Analysis 12
5.3 Intersection Sight Distance Evaluation 13
5.4 Intersection Capacity Analysis 13
5.4.1 Rings Road at Cosgray Road 16
5.4.2 Cosgray Road at Churchman Road 16
5.4.3 Churchman Road at Site Drives 16
5.4.4 Rings Road at Churchman Road 16
5.4.5 Rings Road at Eiterman Road 16
5.4.6 Rings Road/Cara Road at Avery Road 17
5.5 Percentage of Site Traffic 17
6.0 CONCLUSIONS AND RECOMMENDATIONS 17

TABLES

TABLE 1: Street Network Characteristics 3
TABLE 2: Trip Generation Comparison 5
TABLE 3: Turn Lane Warrant Summary 11
TABLE 4: Signal Warrant Summary 12
TABLE 5: Capacity Analysis Summary 14

FIGURES

FIGURE 1: Site Location Map 4
FIGURE 2: Expected Site Trip Distribution 6
FIGURE 3: 2015 AM Peak Volumes 7
FIGURE 4: 2015 PM Peak Volumes 8
FIGURE 5: 2025 AM Peak Volumes 9
FIGURE 6: 2025 PM Peak Volumes 10
FIGURE 7: Recommended 2015 Improvements 18
FIGURE 8: Recommended 2025 Improvements 19

EXHIBIT

EXHIBIT 1: SITE PLAN AND SIGHT DISTANCE EXHIBITS

APPENDICES

APPENDIX A: Correspondence (MOU and Comments)
APPENDIX B: Data Collected (Materials from Lare Tract TIS)
APPENDIX C: Traffic Volume Calculations
APPENDIX D: Turn Lane Warrants
APPENDIX E: Capacity Analysis Reports
APPENDIX F: Turn Lane Sizing Calculations
APPENDIX G: Site Traffic Percentages by Intersection

1.0 INTRODUCTION

This study has been prepared to identify the transportation impact of developing approximately 26 acres known as the Ballantrae Woods (formerly Liggett Tract) in Dublin, Ohio. The proposed development is located on the north side of Rings Road, east of Cosgray Road and along the east side of the existing CSX Transportation railroad tracks. The project site is planned to develop with a mix of condominiums and single family dwelling units with a maximum number of total units not to exceed 141 lots. Three access points are planned to serve the site, which will all connect along Churchman Road north of Rings Road. A portion of the site includes land that is needed to construct the new alignment of Churchman Road, including turn lanes into the proposed site driveways as well as for driveways serving properties opposite the site. A site location map is included as **Figure 1** and a site plan has been included in **Exhibit 1.** An approved memorandum of understanding summarizing the methodology of this study dated on January 13, 2015 is included in **Appendix A** for reference.

2.0 EXISTING CONDITIONS

Existing conditions were identified in **Table 1** below, which identifies the Street Network Characteristics for the surrounding street network.

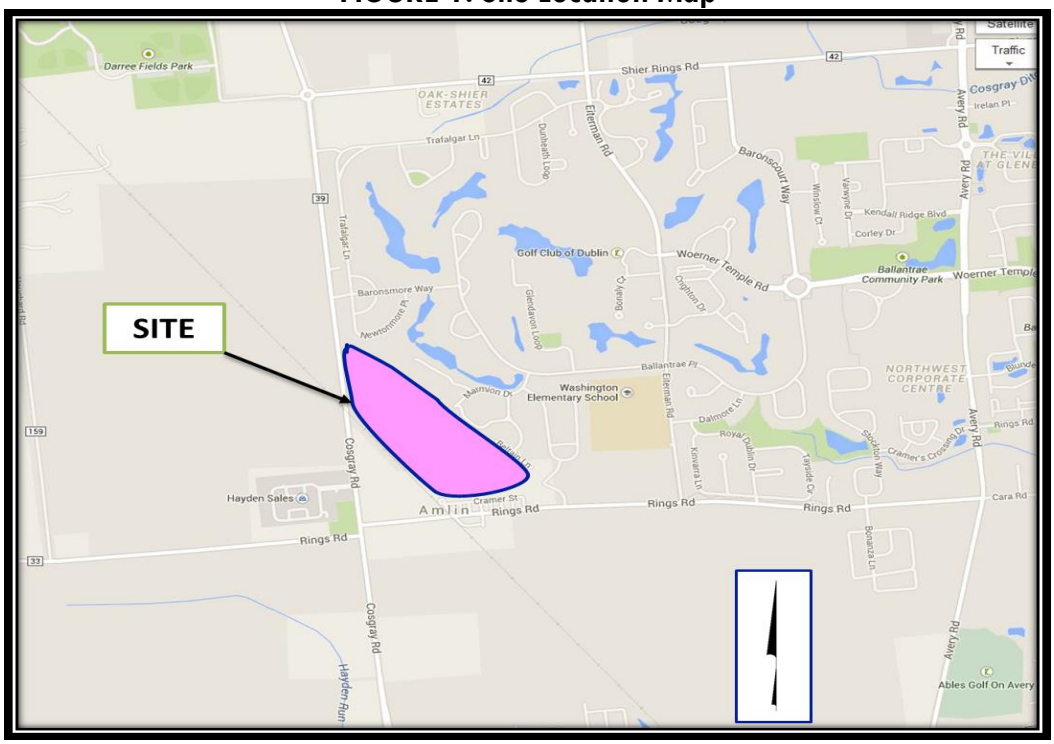
TABLE 1: *Street Network Characteristics*

Street Name	Cardinal Direction	Posted Speed Limit
Rings Road	East/West	35 mph
Cosgray Road	North/South	45 mph
Eiterman Road	North/South	35 mph
Avery Road	North/South	45 mph

3.0 DATA COLLECTED

Manual turning movement volume counts were previously performed by EMH&T personnel at the Rings Road/Cosgray Road and Rings Road/Eiterman Road intersection during both peak hours, as well as at the Rings Road/Avery Road intersection from 7-9 AM. The City of Dublin provided afternoon (4-6 PM) turning movement counts at the Rings Road/Avery Road intersection. These turning movement counts will serve to form the basis of background traffic at those intersections. Previous traffic volume data will be increased to opening and horizon year conditions based on previously accepted growth rates discussed with Dublin personnel and documented in the Lare Tract MOU. Lare Tract is now referred to as Links at Ballantrae. City of Dublin provided 2030 AM and PM peak hour plots from the City's travel demand model so future link volumes along Churchman Road could be derived. Copies of all count data and model output from the Lare Tract TIS are included in **Appendix B** for reference.

FIGURE 1: Site Location Map



4.0 STUDY PROCEDURES

The impact of proposed development on the adjacent street network was determined by combining the estimated site-generated trips from the Ballantrae Woods development with background traffic, including Links at Ballantrae traffic, and analyzing the street system under full build conditions. Background traffic refers to non-site generated traffic volumes and was forecast for both the opening year 2015 and the horizon year 2025. Both morning and afternoon peak hour conditions were analyzed to determine the development impact. Analyses were performed at the intersections listed below:

- Rings Road/Cosgray Road
- Rings Road/Eiterman Road
- Rings Road/Churchman Road
- Rings Road/Avery Road
- Churchman Road/Site Drive(s)
- Cosgray Road/Churchman Road

4.1 Traffic Volume Projections

Detailed traffic volume calculations are attached for reference illustrating the development of 2015 and 2025, background and full build traffic volumes. Horizon year traffic volumes were calculated based on the best available information for each intersection within the study area.

- Background horizon year (2025) traffic volumes at the Rings Road/Cosgray Road and Rings Road/Eiterman Road intersections, and 2015 traffic volumes on Rings Road intersections with Cosgray Road, Eiterman Road and Avery Road as well as Cosgray Road/Churchman Road intersection were developed by expanding 2013 counted traffic volumes with the application of a 3.3 percent growth rate. This growth rate was previously established for the Lare Tract TIS by comparing total entering volumes for 2008/2013 for the intersections of Rings Road/Cosgray Road and Rings Road/Avery Road, and is consistent with the Avondale and Lare Tract TIS preparations. Detailed calculations have been attached for reference.

- For 2025 volumes at Avery Road/Rings Road intersection, the calculation of growth rate of each movement was based on comparison of 2030 model (plate A of Avondale Woods TIS) and 2013 Background traffic volumes (in 5300 Avery Road site TIS). These growth rates were applied to 2013 Background traffic volumes and site trips of Avondale Woods as well as 5300 Avery Road site trips were added to obtain 2025 Full Build traffic volumes. It was assumed that the site trips of Links at Ballantrae and current Liggett development were accounted in 2030 model for this intersection. See calculation of attached plates G and G1.

- Horizon year traffic volumes for Churchman Road were taken from the City of Dublin, travel demand model. 2030 travel demand model projections were reduced to 2025 horizon year conditions assuming linear growth from 2016 to 2030. It is assumed (and consistent with Lare Tract study) that approximately 87 percent of traffic volumes forecast for Churchman Road are expected to use the Rings Road/Churchman Road intersection and approximately 13 percent are expected to use Cosgray Road/Churchman Road.

4.2 Trip Generation

Site generated trip ends will be forecast using data and methodology contained in Trip Generation 9th Edition (Institute of Transportation Engineers, 2012). Morning and afternoon peak hour traffic volumes will be estimated using trip generation rates for Land Use Code 210 (Single Family-Detached Housing). Even though the mix of residential units includes single family and condominium units, all trip generation will be based on the higher single family data. The proposed development is expected to include a combination of no more than 141 units that is estimated to generate 108 external trips in the morning peak hour (27 entering, 81 exiting) and 143 external trips in the afternoon peak hour (90 entering, 53 exiting). Detailed trip generation calculations are shown in **Table 2**.

TABLE 2: Trip Generation Comparison

Land Use	Square Feet or Units	ITE Code	Time Period	ITE Formula	Total Trips	Trips Entering	Trips Exiting
Single Family - Detached	141 units	210	ADT	Ln(T)=0.92Ln(x)+2.72	1,442	721	721
			AM Peak	T=0.70(x)+9.74	108	27	81
			PM Peak	Ln(T)=0.90Ln(x)+0.51	143	90	53

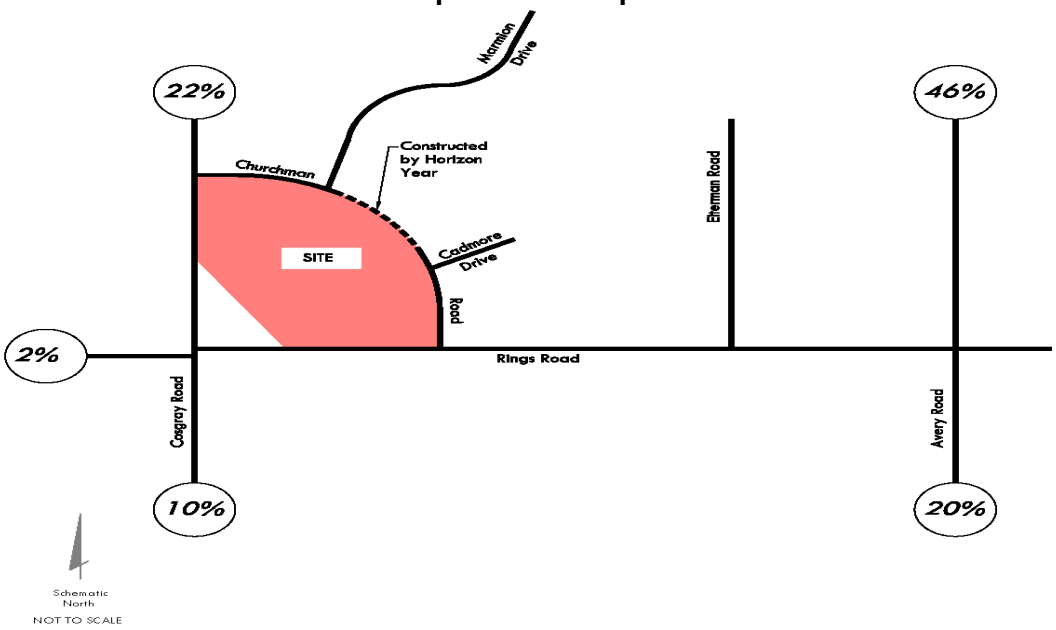
4.3 Trip Distribution

Site generated traffic volumes will be assigned to the adjacent street network according to the distribution used in the *Lare Tract Traffic Study* published in 2013. This distribution is illustrated in

Figure 2 below. All trips will be assigned to the adjacent street network via Churchman Road to the adjacent street network. Some site generated trips may use adjacent residential streets opposite Churchman Road but all site traffic was assigned to the gateways for simplicity in completing this study.

In the opening year, it is assumed that Churchman Road will be available to serve the Ballantrae Woods site from Marmion Drive north to Cosgray Road only. All site traffic will be assigned via these connections in the Opening Year only. By the 2025 Horizon Year, the full connection and reconstruction of Churchman Road to the south, connecting to Rings Road, is assumed to be in place. Consequently, the Links at Ballantrae site traffic will also be re-assigned in the Opening Year to only the Rings Road intersection via Churchman Road. By the Horizon Year, the full connections and completion of Churchman Road will allow the Links at Ballantrae site traffic to be fully distributed as indicated in that TIS for the Horizon Year.

FIGURE 2: Expected Site Trip Distribution



Site traffic was combined with background traffic volumes described above to develop 2015 and 2025 peak hour traffic volumes for the study area. The 2015 AM/PM and 2025 AM/PM volumes are included in the following pages for reference:

Figure 3: 2015 AM Peak Volumes

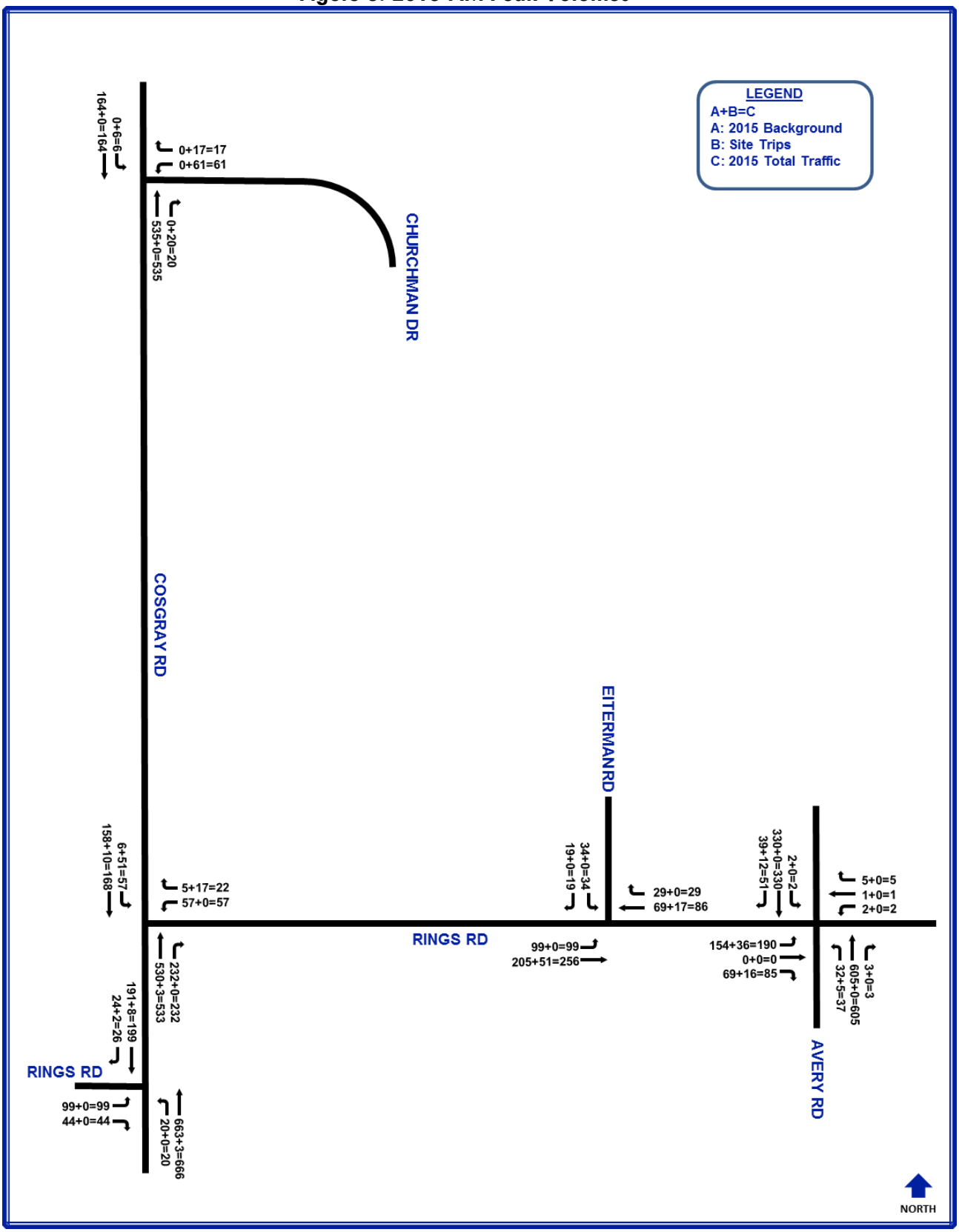


Figure 4: 2015 PM Peak Volumes

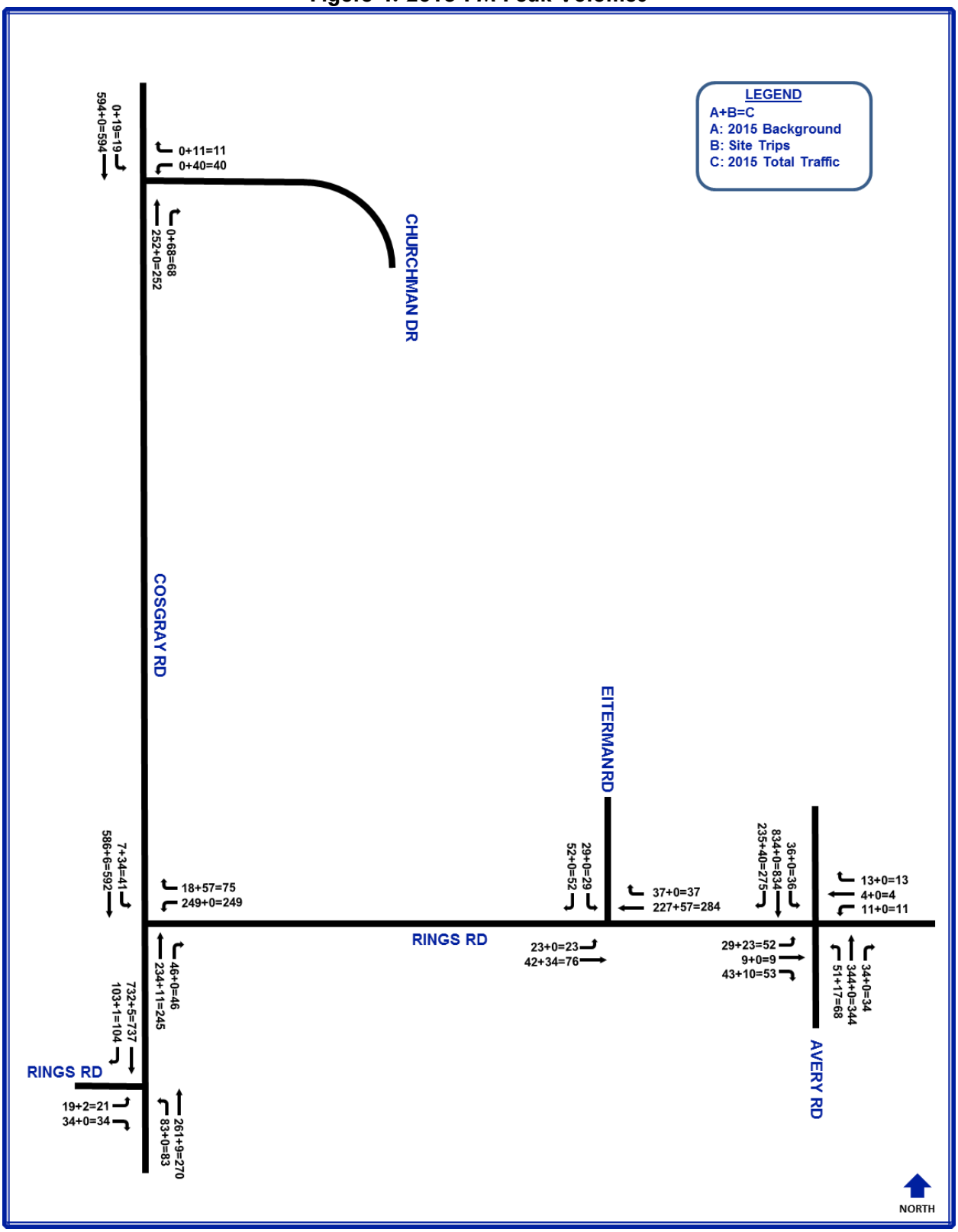


Figure 5: 2025 AM Peak Volumes

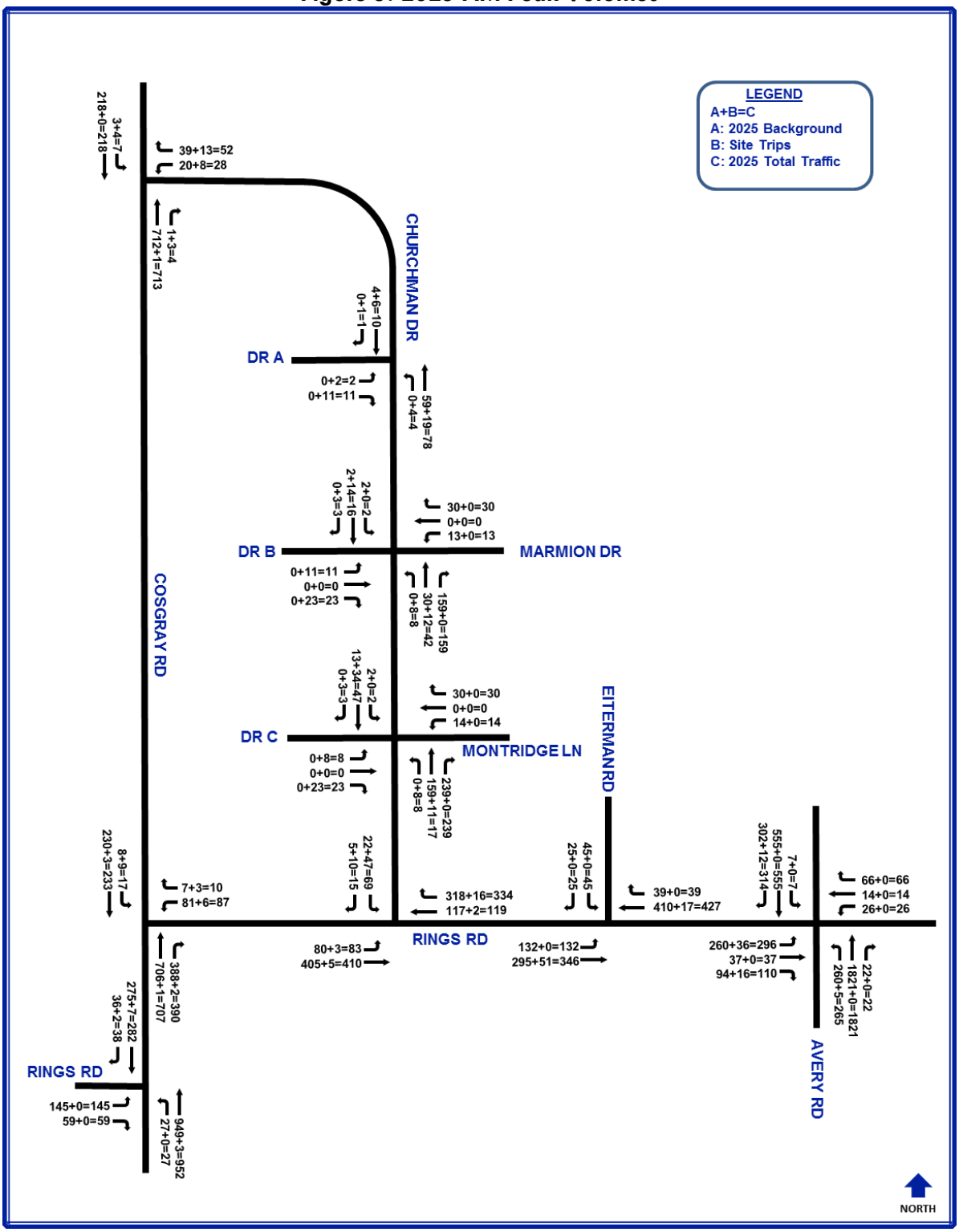
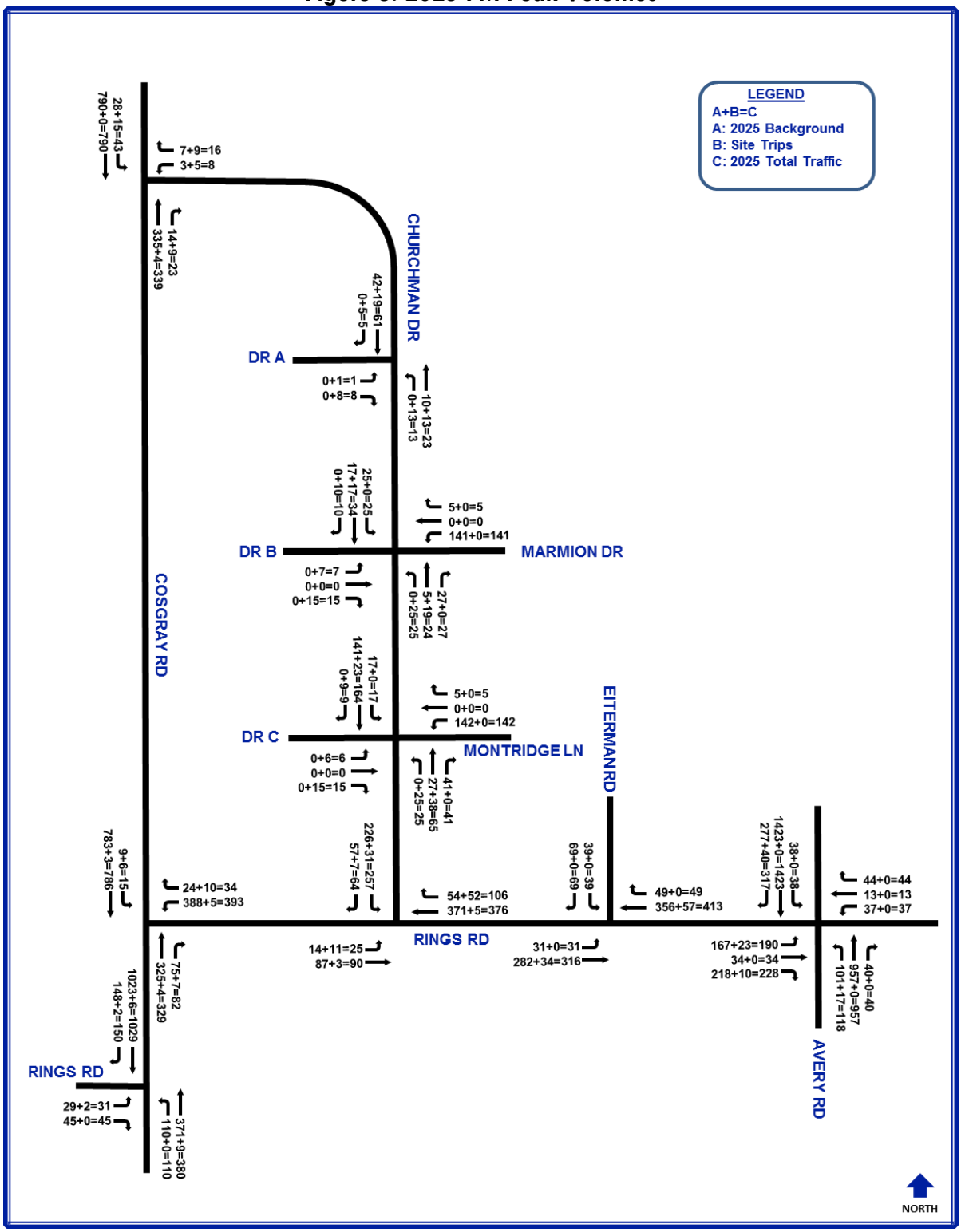


Figure 6: 2025 PM Peak Volumes



5.0 FINDINGS OF ANALYSES

Opening year (2015) and horizon year (2025) volumes were used to analyze the street system with combinations of background traffic and site generated traffic volumes. Turn lane warrant criteria was reviewed and capacity analyses were completed to determine if any improvements are needed to mitigate site related traffic impacts. A few warranted turn lanes are not recommended since roundabouts are planned for those locations.

5.1 Turn Lane Warrants/Storage Requirements

Left and right turn lane warrants were evaluated pursuant to the requirements set forth in the Location and Design Manual, § 401.6 (Ohio Department of Transportation, 2013). Turn lane warrant results at each location are illustrated in **Table 3** below:

TABLE 3: Turn Lane Warrant Summary

Intersection	Movement	Warranted			
		2015 Background	2015 Full Build	2025 Background	2025 Full Build
Cosgray Rd @ Churchman Rd	NBRT	N/A	YES	N/A	NO
	SBLT	N/A	YES	N/A	YES
Rings Rd @ Eiterman Rd	WBRT	NO	NO	NO	NO
	EBLT	NO	NO	YES	YES

Based on projected 2015 Build traffic volumes, a northbound right turn lane is predicted to be warranted at the Cosgray Road/Rings Road intersection since Churchman Drive is not yet connected south to Rings Road forcing site traffic to enter there, and the assumption that full site buildout will occur in the first year which is not expected to occur. When Churchman Road is extended to Rings Road shortly after Opening Year, predicted 2025 Build conditions do not warrant this northbound right turn lane. Consequently, a northbound right turn lane at Cosgray Road/Churchman Road is not recommended for the temporary opening year conditions. A southbound left turn lane is warranted at Cosgray Rd/Churchman Rd in the PM peak Build condition tied to the Build condition. Since the southbound left turn lane on Cosgray Road at Churchman is not needed for capacity, and that pavement would be removed when a planned roundabout is constructed, this improvement is not recommended at this time. In lieu of providing a turn lane there, the developer is planning to donate land there to assist planning efforts for the future roundabout.

At the Eiterman Road/Rings Road intersection, an eastbound left turn is potentially warranted with 2015 background traffic volumes but is borderline for meeting the warrant. When 2015 Build conditions are considered, the warrant threshold is again borderline and since the site is not expected to reach full buildout for some time, it is unlikely that this left turn movement will be warranted in 2015. In our opinion, a future eastbound left turn on Rings Road at Eiterman should be provided at a later time when volumes actually reach warrant levels, which warrants indicate will be met with 2025 Background conditions. Left turn lanes on Churchman Road at each established site drive location should be 100 feet in length, which are planned to be 150 feet in length as part of the City's Phase 1/2 plans for Churchman Road construction currently in for review and approval. Turn lane warrants and lane sizing data are attached in Appendix D and Appendix F for reference.

5.2 Signal Warrant Analysis

Traffic signal warrants were previously evaluated for the Rings Road/Cosgray Road intersection in the 2013 Lare Tract TIS and a traffic signal was found to be warranted based on 2013 background traffic volumes at that time. Traffic signal warrants were completed by comparing current volumes at that time to minimum volume thresholds established by the Ohio Manual of Uniform Traffic Control Devices § 4C (Ohio Department of Transportation, 2012) (OMUTCD). Volumes at that intersection were found to meet volume criteria specified in Warrant 1, Eight-Hour Warrant as well as Warrant 2, Four-Hour Warrant and Warrant 3, Peak Hour Warrant.

Similarly, traffic volumes observed at the Rings Road/Avery Road intersection for the Avondale TIS in 2014 revealed that 2014 background traffic levels met Warrant 1 criterial for signalization at that time. The signal warrant worksheets for both intersections, completed in previous studies, are included for reference in **Appendix C**. **Table 4** below illustrates the results of the warrant analyses at these two intersections:

TABLE 4: Signal Warrant Summary

Warrant Type	Rings Rd/Cosgray Rd 2013 Background*	Rings Rd/Avery Rd/Cara Rd 2014 Background**
Warrant 1, Eight-Hour	Yes	Yes
Warrant 2, Four-Hour	Yes	N/A
Warrant 3, Peak Hour	Yes	N/A

* from Lare Tract TIS, ** from Avondale TIS

5.3 Intersection Sight Distance Evaluation

The Location and Design Manual § 201.3 (Ohio Department of Transportation, 2013) provides recommended intersection sight distance requirements for given design speeds. These requirements were compared to Build conditions on Churchman Road at the three planned site drives. The required Intersection Sight Distance (ISD) for a 35-mph roadway is based on a 40-mph design speed, which is 445 feet. Since the development is fairly level, only horizontal obstructions seem likely to limit ISD at each drive location. However, since Churchman Road nor the site driveways do not currently exist, exhibits identifying current sight distance based on survey data are based on horizontal datum, vertical issues are assumed to be addressed in the Churchman Road design.

The sight distance exhibits identify sight triangles where future landscaping and other amenities should not be located. As detailed design is completed for these access connections, the sight triangles should be reviewed at each planned connection to Churchman Road during roadway plan review. Sight distance exhibits have been prepared for the three planned Churchman Road connections and are included at the end of this report in the Exhibit 1 section.

5.4 Intersection Capacity Analysis

Highway Capacity Software and Synchro were used to evaluate operational characteristics of traditional study area intersections and SIDRA was used to model modern roundabout intersections. Intersections are graded using a level of service designation. Levels of Service (LOS) are expressed in terms of letter grades with LOS A representing the highest quality traffic flow and minimal delay, and LOS F representing poor traffic operations and significant delay. LOS D or better for each approach at an intersection is desirable. Capacity results are summarized and in **Table 5.** Output reports of capacity analysis are attached in Appendix E for reference.

TABLE 5: Capacity Analysis Summary

Time Period	Year	Scenario	Conditions	EBLT	EBTH	EBRT	APPROACH	WBLT	WBTH	WBRT	APPROACH	NBLT	NBTH	NBRT	APPROACH	SBLT	SBTH	SBRT	APPROACH	TOTAL
Rings Road North/Cosgray Road																				
AM Peak Hour	2015	Background	Existing Condition	-	-	-	-	C/19.0	-	C/19.0	C/19.0	-	-	-	-	A/9.5	A/9.5	-	-	-
		Full Build	Existing Condition	-	-	-	-	C/23.3	-	C/23.3	C/23.3	-	-	-	-	A/9.8	A/9.8	-	-	-
	2025	Background	Existing Condition	-	-	-	-	E/39.5	-	E/39.5	E/39.5	-	-	-	-	B/11.2	B/11.2	-	-	-
		Full Build	Existing Condition	-	-	-	-	E/45.6	-	E/45.6	E/45.6	-	-	-	-	B/11.3	B/11.3	-	-	-
PM Peak Hour	2015	Background	Existing Condition	-	-	-	-	F/73.6	-	F/73.6	F/73.6	-	-	-	-	A/7.9	A/7.9	-	-	-
		Full Build	Existing Condition	-	-	-	-	F/143.5	-	F/143.5	F/143.5	-	-	-	-	A/8.0	A/8.0	-	-	-
	2025	Background	Existing Condition	-	-	-	-	F/636.1	-	F/636.1	F/636.1	-	-	-	-	A/8.2	A/8.2	-	-	-
		Full Build	Existing Condition	-	-	-	-	F/701.2	-	F/701.2	F/701.2	-	-	-	-	A/8.3	A/8.3	-	-	-
Rings Road South/Cosgray Road																				
AM Peak Hour	2015	Background	Existing Condition	C/24.1	-	C/24.1	C/24.1	-	-	-	-	A/7.8	A/7.8	-	-	-	-	-	-	-
		Full Build	Existing Condition	C/24.7	-	C/24.7	C/24.7	-	-	-	-	A/7.8	A/7.8	-	-	-	-	-	-	-
	2025	Background	Existing Condition	F/162.0	-	F/162.0	F/162.0	-	-	-	-	A/8.0	A/8.0	-	-	-	-	-	-	-
		Full Build	Existing Condition	F/166.8	-	F/166.8	F/166.8	-	-	-	-	A/8.1	A/8.1	-	-	-	-	-	-	-
PM Peak Hour	2015	Background	Existing Condition	C/24.3	-	C/24.3	C/24.3	-	-	-	-	B/10.5	B/10.5	-	-	-	-	-	-	-
		Full Build	Existing Condition	D/25.5	-	D/25.5	D/25.5	-	-	-	-	B/10.5	B/10.5	-	-	-	-	-	-	-
	2025	Background	Existing Condition	F/86.9	-	F/86.9	F/86.9	-	-	-	-	B/13.5	B/13.5	-	-	-	-	-	-	-
		Full Build	Existing Condition	F/98.3	-	F/98.3	F/98.3	-	-	-	-	B/13.6	B/13.6	-	-	-	-	-	-	-
Rings Road/Cosgray Road																				
AM Peak Hour	2015	Background	Signalized	B/12.8	B/12.8	B/12.8	B/12.8	B/11.6	B/11.6	B/11.6	B/11.6	A/5.1	A/5.1	A/5.1	A/5.1	A/3.0	A/3.0	A/3.0	A/3.0	A/6.2
			Roundabout w/ 1 SB through lane	B/13.9	A/3.7	A/6.4	A/6.8	B/13.9	A/4.6	A/6.3	B/11.2	B/13.3	A/6.1	A/7.0	A/6.6	B/11.0	A/5.5	A/6.2	A/5.7	A/6.7
		Full Build	Signalized	B/13.4	B/13.4	B/13.4	B/13.4	B/12.5	B/12.5	B/12.5	B/12.5	A/5.1	A/5.1	A/5.1	A/5.1	A/3.2	A/3.2	A/3.2	A/3.2	A/6.3
			Roundabout w/ 1 SB through lane	B/14.3	A/4.1	A/6.8	A/7.2	B/14.0	A/4.7	A/6.5	B/10.2	B/14.1	A/6.9	A/7.8	A/7.3	B/11.0	A/5.5	A/6.2	A/7.0	A/7.4
	2025	Background	Signalized	C/22.8	C/22.8	C/22.8	C/22.8	C/20.3	C/20.3	C/20.3	C/20.3	B/12.2	B/12.2	B/12.2	B/12.2	A/3.6	A/3.6	A/3.6	A/3.6	B/12.7
			Roundabout w/ 1 SB through lane	B/14.6	A/4.5	A/7.2	A/7.4	B/16.3	A/7.0	A/8.7	B/13.6	C/20.4	B/13.3	B/14.2	B/13.7	B/11.3	A/5.7	A/6.5	A/6.0	B/11.6
			Roundabout w/ 2 SB through lane	B/14.3	A/4.1	A/6.6	A/7.0	B/16.3	A/7.0	A/8.7	B/13.6	C/20.2	B/13.1	B/14.0	B/13.5	B/11.0	A/5.8	A/6.4	A/6.0	B/11.5
		Full Build	Signalized	C/22.9	C/22.9	C/22.9	C/22.9	C/20.7	C/20.7	C/20.7	C/20.7	B/12.4	B/12.4	B/12.4	B/12.4	A/3.7	A/3.7	A/3.7	A/3.7	B/12.9
			Roundabout w/ 1 SB through lane	B/14.8	A/4.6	A/7.3	A/7.5	B/16.4	A/7.0	A/8.8	B/13.6	C/22.2	B/15.1	B/16.0	B/15.6	B/11.3	A/5.8	A/6.5	A/6.2	B/12.8
			Roundabout w/ 2 SB through lane	B/14.4	A/4.2	A/6.7	A/7.1	B/16.4	A/7.0	A/8.8	B/13.6	C/22.0	B/14.9	B/15.7	B/15.3	B/11.0	A/5.8	A/6.5	A/6.2	B/12.6
PM Peak Hour	2015	Background	Signalized	B/10.4	B/10.4	B/10.4	B/10.4	B/13.0	B/13.0	B/13.0	B/13.0	A/5.8	A/5.8	A/5.8	A/5.8	A/7.3	A/7.3	A/7.3	A/7.3	A/8.3
			Roundabout w/ 1 SB through lane	B/18.7	A/8.5	B/11.3	B/12.6	B/12.5	A/3.2	A/4.9	A/9.7	B/12.3	A/5.1	A/6.0	A/7.0	B/17.7	B/12.1	B/12.9	B/12.3	B/10.3
		Full Build	Signalized	B/11.3	B/11.3	B/11.3	B/11.3	B/15.1	B/15.1	B/15.1	B/15.1	A/6.9	A/6.9	A/6.9	A/6.9	A/9.2	A/9.2	A/9.2	A/9.2	B/10.1
			Roundabout w/ 1 SB through lane	B/19.4	A/9.2	B/11.9	B/13.4	B/12.8	A/3.5	A/5.2	A/9.2	B/12.6	A/5.4	A/6.3	A/7.2	B/19.1	B/13.5	B/14.3	B/14.0	B/11.1
	2025	Background	Signalized	B/15.8	B/15.8	B/15.8	B/15.8	C/25.0	C/25.0	C/25.0	C/25.0	B/15.2	B/15.2	B/15.2	B/15.2	B/17.7	B/17.7	B/17.7	B/17.7	B/18.6
			Roundabout w/ 1 SB through lane	C/22.1	B/11.9	B/14.7	B/16.1	B/15.8	A/6.5	A/8.2	B/13.2	B/12.4	A/5.2	A/6.1	A/7.0	F/118.4	F/112.9	F/113.6	F/113.0	E/56.6
			Roundabout w/ 2 SB through lane	B/17.9	A/7.7	B/10.3	B/11.7	B/15.8	A/6.5	A/8.2	B/13.2	B/12.4	A/5.2	A/6.1	A/7.0	B/15.7	B/10.0	B/10.2	B/10.1	B/10.1
		Full Build	Signalized	B/16.7	B/16.7	B/16.7	B/16.7	C/28.5	C/28.5	C/28.5	C/28.5	B/17.7	B/17.7	B/17.7	B/17.7	B/19.0	B/19.0	B/19.0	B/19.0	C/20.8
			Roundabout w/ 1 SB through lane	C/22.1	B/11.9	B/14.6	B/16.1	B/16.3	A/6.9	A/8.7	B/13.6	B/12.4	A/5.3	A/6.2	A/7.0	F/128.6	F/123.1	F/123.8	F/123.2	E/60.9
			Roundabout w/ 2 SB through lane	B/18.0	A/7.8	B/10.4	B/11.9	B/16.3	A/6.9	A/8.7	B/13.6	B/12.5	A/5.3	A/6.2	A/7.1	B/16.0	B/10.2	B/10.4	B/10.4	B/10.3
Cosgray Road/Churchman Road																				
AM Peak Hour	2015	Full Build	Stop controlled "tee"	-	-	-	-	C/16.9	-	C/16.9	C/16.9	-	-	-	-	A/8.7	-	-	-	-
	2025	Background	Stop controlled "tee"	-	-	-	-	C/17.9	-	C/17.9	C/17.9	-	-	-	-	A/9.3	-	-	-	-
		Full Build	Stop controlled "tee"	-	-	-	-	C/19.4	-	C/19.4	C/19.4	-	-	-	-	A/9.3	-	-	-	-
PM Peak Hour	2015	Full Build	Stop controlled "tee"	-	-	-	-	C/19.1	-	C/19.1	C/19.1	-	-	-	-	A/8.0	-	-	-	-
	2025	Background	Stop controlled "tee"	-	-	-	-	C/15.1	-	C/15.1	C/15.1	-	-	-	-	A/8.1	-	-	-	-
		Full Build	Stop controlled "tee"	-	-	-	-	C/16.5	-	C/16.5	C/16.5	-	-	-	-	A/8.2	-	-	-	-
Churchman Road/Drive A																				
AM Peak Hour	2025	Full Build	Stop controlled "tee"	A/8.5	-	A/8.5	A/8.5	-	-	-	-	A/7.2	-	-	-	-	-	-	-	-
PM Peak Hour	2025	Full Build	Stop controlled "tee"	A/8.7	-	A/8.7	A/8.7	-	-	-	-	A/7.4	-	-	-	-	-	-	-	-
Churchman Road/Drive B/Marmion Dr																				
AM Peak Hour	2025	Full Build	Stop controlled	A/9.0	-	A/9.0	A/9.0	A/9.4	-	A/9.4	A/9.4	A/7.3	-	-	-	A/7.7	-	-	-	-
PM Peak Hour	2025	Full Build	Stop controlled	A/9.0	-	A/9.0	A/9.0	B/11.2	-	B/11.2	B/11.2	A/7.3	-	-	-	A/7.4	-	-	-	-
Churchman Road/Drive C/Montridge Ln																				
AM Peak Hour	2025	Full Build	Stop controlled	A/9.6	-	A/9.6	A/9.6	B/10.9	-	B/10.9	B/10.9	A/7.3	-	-	-	A/8.2	-	-	-	-
PM Peak Hour	2025	Full Build	Stop controlled	A/9.9	-	A/9.9	A/9.9	B/13.9	-	B/13.9	B/13.9	A/7.6	-	-	-	A/7.5	-	-	-	-

X/X = Overall LOS / Average Delay Per Vehicle

TABLE 5: Capacity Analysis Summary, cont.

Time Period	Year	Scenario	Conditions	EBLT	EBTH	EBRT	APPROACH	WBLT	WBTH	WBRT	APPROACH	NBLT	NBTH	NBRT	APPROACH	SBLT	SBTH	SBRT	APPROACH	TOTAL
Rings Road/Churchman Road																				
AM Peak Hour	2015	Full Build	Stop controlled "tee"	A/7.4	-	-	-	-	-	-	-	-	-	-	-	B/10.4	-	B/10.4	B/10.4	-
	2025	Background	Roundabout	A/7.6	A/2.6	-	A/3.4	-	A/3.0	A/3.5	A/3.3	-	-	-	-	A/8.9	-	A/2.3	A/7.7	A/3.5
		Full Build	Roundabout	A/8.0	A/3.0	-	A/3.8	-	A/3.0	A/3.5	A/3.4	-	-	-	-	A/8.9	-	A/2.3	A/7.7	A/4.0
PM Peak Hour	2015	Full Build	Stop controlled "tee"	A/8.0	-	-	-	-	-	-	-	-	-	-	-	B//11.0	-	B//11.0	B//11.0	-
	2025	Background	Roundabout	A/8.9	A/3.8	-	A/4.5	-	A/2.4	A/2.9	A/2.5	-	-	-	-	B/11.2	-	A/4.6	A/9.9	A/5.3
		Full Build	Roundabout	A/9.31	A/4.1	-	A/5.2	-	A/2.5	A/3.0	A/2.6	-	-	-	-	B/11.4	-	A/4.8	B/10.1	A/5.6
Rings Road/Eiterman Road																				
AM Peak Hour	2015	Background	Existing condition	A/7.6	A/7.6	-	-	-	-	-	-	-	-	-	-	B/13.2	-	A/8.8	B/11.7	-
		Full Build	Existing condition	A/7.7	A/7.7	-	-	-	-	-	-	-	-	-	-	B/14.2	-	A/8.9	B/12.3	-
	2025	Background	+EBLT	A/8.9	-	-	-	-	-	-	-	-	-	-	-	D/27.0	-	B/11.3	C/21.4	-
		Full Build	+EBLT	A/9.0	-	-	-	-	-	-	-	-	-	-	-	D/30.4	-	B/11.5	C/23.6	-
PM Peak Hour	2015	Background	Existing condition	A/7.9	-	-	-	-	-	-	-	-	-	-	-	B/11.1	-	B/10.0	B/10.4	-
		Full Build	Existing condition	A/8.0	-	-	-	-	-	-	-	-	-	-	-	B/12.0	-	B/10.5	B/11.0	-
	2025	Backgound	+EBLT	A/8.3	-	-	-	-	-	-	-	-	-	-	-	C/16.7	-	B/11.4	B/13.3	-
		Full Build	+EBLT	A/8.5	-	-	-	-	-	-	-	-	-	-	-	C/18.7	-	B/12.0	B/14.4	-
Rings Road/Avery Road/Cara Road																				
AM Peak Hour	2015	Background	Existing condition	F/124.6	F/124.6	F/124.6	F/124.6	C/18.6	C/18.6	C/18.6	C/18.6	A/8.2	A/8.2	A/8.2	-	A/8.9	A/8.9	A/8.9	-	-
			Signalized	C/26.1	C/26.1	C/26.1	C/26.1	C/20.5	C/20.5	C/20.5	C/20.5	A/7.0	A/7.0	A/7.0	A/7.0	A/4.9	A/4.9	A/4.9	A/4.9	A/9.9
		Full Build	Signalized	C/24.6	C/24.6	C/24.6	C/24.6	B/18.3	B/18.3	B/18.3	B/18.3	A/9.0	A/9.0	A/9.0	A/9.0	A/6.4	A/6.4	A/6.4	A/6.4	B/11.6
	2025	Background	Roundabout	B/15.7	A/5.5	B/10.0	B/13.3	E/58.1	D/49.2	D/50.8	D/52.4	F/89.4	F/82.8	F/83.0	F/83.6	B/12.5	A/7.8	A/8.0	A/7.9	E/55.9
		Full Build	Roundabout	B/16.1	A/5.9	B/10.0	B/13.7	D/39.2	C/30.3	C/31.9	C/33.4	F/153.1	F/146.9	F/147.3	F/147.6	B/12.3	A/7.6	A/7.8	A/7.7	F/92.7
PM Peak Hour	2015	Background	Existing condition	F/100.6	F/100.6	F/100.6	F/100.6	F/56.5	F/56.5	F/56.5	F/56.5	B/11.6	B/11.6	B/11.6	-	A/8.3	A/8.3	A/8.3	-	-
			Signalized	C/26.0	C/26.0	C/26.0	C/26.0	C/24.1	C/24.1	C/24.1	C/24.1	A/2.7	A/2.7	A/2.7	A/2.7	B/10.2	B/10.2	B/10.2	B/10.2	A/9.3
		Full Build	Signalized	C/27.5	C/27.5	C/27.5	C/27.5	C/24.6	C/24.6	C/24.6	C/24.6	A/4.0	A/4.0	A/4.0	A/4.0	B/15.1	B/15.1	B/15.1	B/15.1	B/13.2
	2025	Background	Roundabout	C/26.8	B/16.6	B/16.2	C/20.4	B/16.2	A/7.3	A/9.0	B/11.6	B/14.2	A/7.9	A/8.3	A/8.5	B/13.4	A/8.5	A/8.6	A/8.6	B/10.1
		Full Build	Roundabout	C/32.5	C/22.4	B/18.5	C/24.7	B/16.6	A/7.7	A/9.3	B/12.0	B/14.8	A/8.5	A/8.8	A/9.2	B/14.7	A/9.8	A/9.9	A/10.0	B/11.7

X/X = Overall LOS / Average Delay Per Vehicle

5.4.1 **Rings Road at Cosgray Road**

This intersection was previously evaluated for signal warrants in the 2013 *Lare Tract TIS*. Those results showed that Warrant 1 (eight hour), Warrant 2 (four hour), and Warrant 3 (peak hour) were warranted in year 2013 under background conditions. Copies of traffic signal warrant worksheets from the Lare Tract TIS are included in Appendix B for reference. The methodology of the evaluation was in accordance with Ohio Manual of Uniform Traffic Control Devices 4c (Ohio Department of Transportation, 2013). Therefore, it is assumed that this intersection is signalized in 2015 under background conditions for the purpose of this study. The intersection is expected to operate at acceptable levels of service (LOS C or better) in the opening and horizon years with a traffic signal. The need for a traffic signal here is due to current/background traffic volumes.

5.4.2 **Cosgray Road at Churchman Road**

This intersection is predicted to operate at LOS C or better for each movement through the 2025 Horizon Year with two-way stop control. These acceptable results are based on utilizing only the existing single lane approaches on Cosgray Road and do not include added turn lanes. A warranted southbound left turn lane due to added site traffic is not expected to be needed to obtain good LOS here. Results predict good level of service until the planned single lane roundabout is constructed in the City's Phase III plan. The developer has already made available needed right of way from this site property to help in the provision of the roundabout there. The developer will continue to work with the City to coordinate the dedication of right of way at this location for the future roundabout. No improvements are needed to provide the expected acceptable level of service.

5.4.3 **Churchman Road at Site Drives**

Each of the three proposed site drive intersections along Churchman Road are predicted to operate at LOS B or better in the 2015 Opening and 2025 Horizon Year with two-way stop control. Plans to construct Churchman Road along the north site frontage already include the left turn lane to enter Downan Drive there (Phase I plan). The middle portion of Churchman (Phase II plan) that will be constructed on this site property also includes these planned turn lanes as part of the roadway plans. Phase II Churchman Road plans are currently submitted for Stage I review.

5.4.4 **Rings Road at Churchman Road**

Per City of Dublin, up to 10 lots of Links at Ballantrae could be built in year 2015 and generate Opening Year traffic. Since Churchman Road will not connect north to the Liggett site in year 2015, it will only serve Ballantrae traffic at the Rings Road intersection. The Churchman/Rings intersection is expected to operate at LOS B or better in 2015 under two-way stop control. The City of Dublin has plans to convert this intersection to roundabout operation by 2025 in Phase II Churchman Road, which is predicted to operate acceptably with LOS B or better under 2025 conditions as a one-lane roundabout.

5.4.5 **Rings Road at Eiterman Road**

The Rings Road/Eiterman Road intersection is expected to operate at an acceptable level (LOS C or better) under AM and PM peak hour traffic volumes with existing conditions through the 2025 Horizon Year with the addition of site generated traffic volumes.

5.4.6 Rings Road/Cara Road at Avery Road

As a signalized intersection in 2015, as warranted in the Avondale Woods Site TIS, the Rings Road/Avery Road/Cara Road intersection is predicted to operate at LOS C or better for each movement under AM/PM peak background and full build conditions.

Per the City's direction, 2025 analyses were completed under assumed roundabout control at the Rings Road/Avery Road intersection. With a roundabout, the intersection is expected to operate at LOS F overall in the AM Peak and LOS C overall in the PM Peak, with or without added site traffic. It appears that Avery Road will need to be widened to a 4 or 5 lane roadway by 2025 based on travel demand volumes suggested by the City model. For this study, one likely lane configuration was assumed throughout all conditions to evaluate the impact of added site traffic. Table 4 above indicates that with the addition of site traffic, no degradation is expected in terms of LOS. Therefore, no site-related improvements are identified for this intersection.

5.5 Percentage of Site Traffic

The percent of both AM and PM peak hour site traffic contribution to the total combined AM/PM Peak hour traffic has been calculated at each of the following study area intersections and attached in Appendix G for reference:

- Rings Road/Cosgray Road – 1.8% (59 veh/3324 veh)
- Cosgray Road/Churchman Road – 3.2% (71 veh/2241 veh)
- Rings Road/Churchman Road – 9.9% (192 veh/1948 veh)
- Rings Road/Avery Road – 2.3% (159 veh/6972 veh)

6.0 CONCLUSION AND RECOMMENDATIONS

The access plan for Ballantrae Woods provides efficient access for the planned development. Left turn lanes are included in Phase I/II Churchman Road plans by the City at each planned site drive that are 150 feet long, including a 50-foot drop taper. Intersection sight distance criteria should be evaluated at each proposed site drive location when roadway plans are being finalized there. No interim turn lanes are recommended at Cosgray Road/Churchman Road since Opening Year conditions are expected to last briefly. Additionally, southbound left turn lane construction is not recommended there since the intersection is predicted to operate acceptably without the added lane, which would be removed anyway when the planned roundabout is constructed there. The Churchman Road/Rings Road and Eiterman Road/Rings Road intersections are expected to have reserve capacity to serve traffic levels through the 2025 Horizon Year Build conditions.

The Rings Road/Cosgray Road intersection is expected to operate acceptably under 2015 and 2025 background and Build conditions with traffic signal control that is currently warranted on background traffic levels. Without the warranted signal, previous analyses from the *Lare Tract* study suggest poor level of service due to side street delay not related to the addition of site traffic. A background improvement to install a traffic signal or roundabout there will improve the background side street delay. Addition of site traffic at this intersection is temporary until Churchman is connected to Rings Road and will be 1.8% once the Rings Road connection is made.

Added site traffic does not significantly alter the overall operating level-of-service. As a result, site related improvements at Rings Road/Cosgray Road are not recommended.

The Rings Road/Avery Road intersection is expected to operate at an acceptable level of service as a signalized intersection in the 2015 Opening Year. Signalized control in the opening year has been warranted in a previous study based on background traffic and is not triggered by the Ballantrae Woods development. In the horizon year, the Rings Road/Avery Road intersection is predicted to operate with an overall failed level of service in the AM Peak under roundabout control unless additional lanes are added on Avery Road to provide sufficient capacity. The lacking capacity is considered a background need and not site-related. Site related improvements are not recommended at this intersection.

Figure 7: Recommended 2015 Improvements

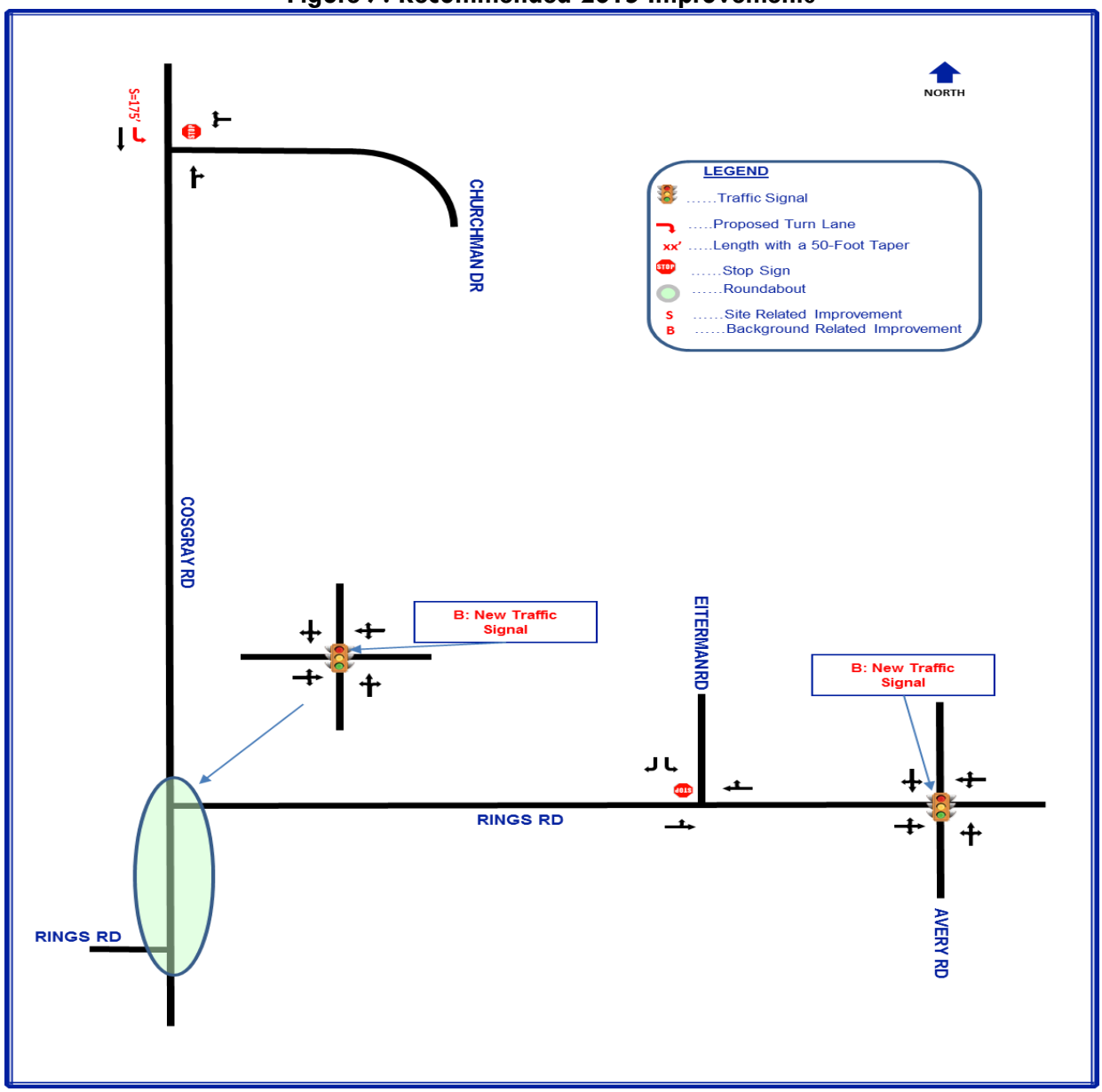


Figure 8: Recommended 2025 Improvements

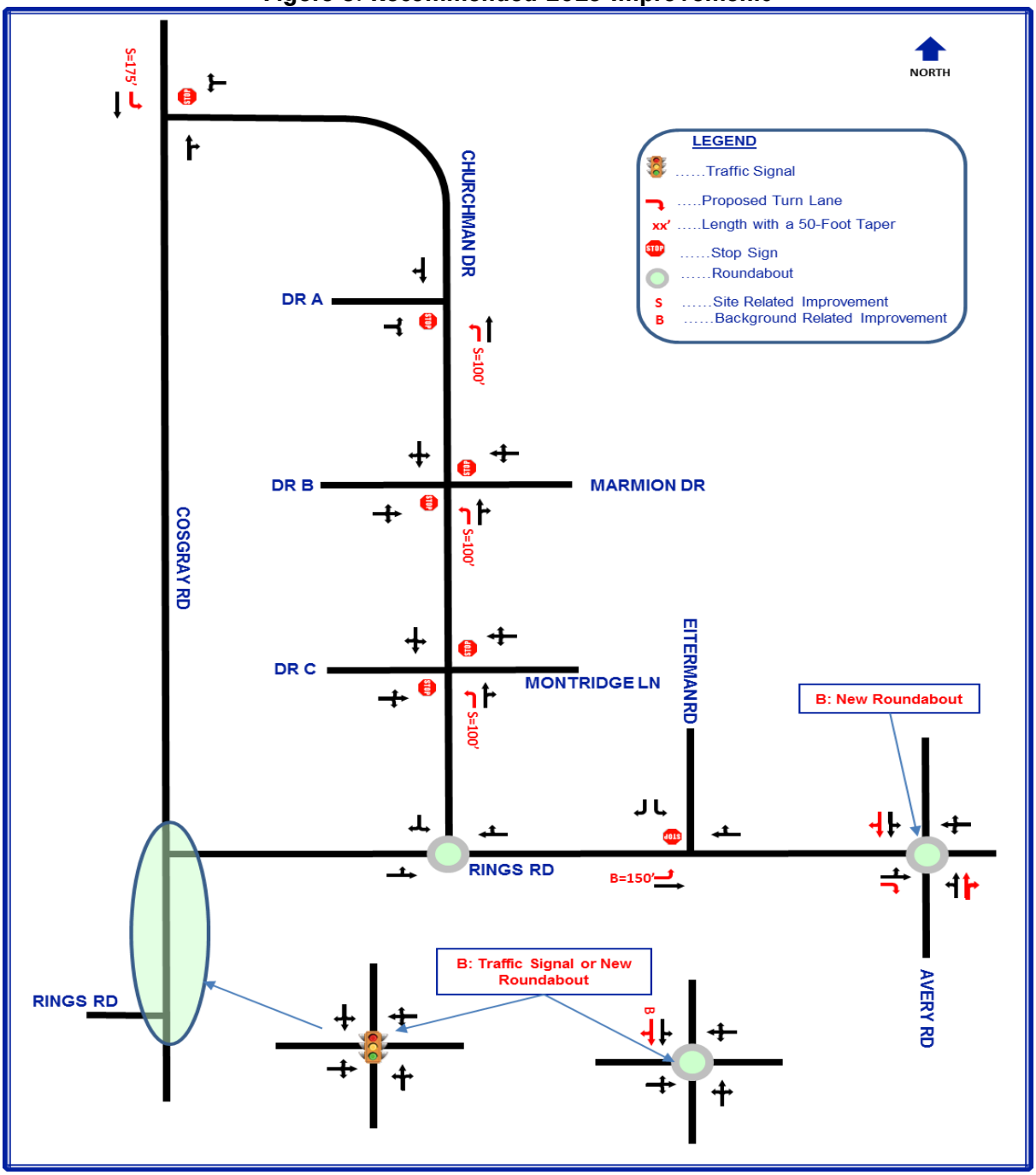
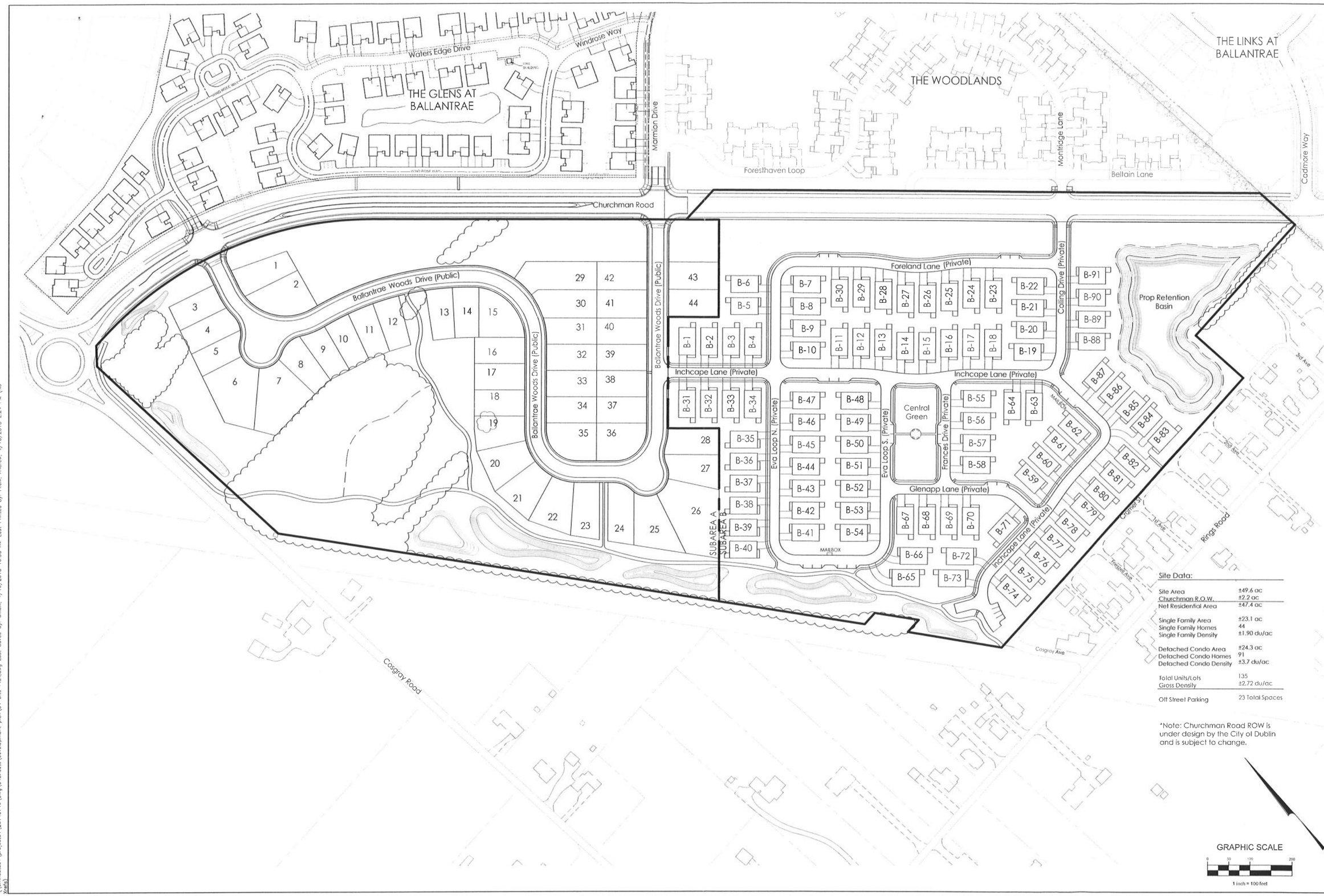


EXHIBIT 1
SITE PLAN AND SIGHT DISTANCE EXHIBITS



Site Data:

Site Area	±49.6 ac
Churchman R.O.W.	±2.2 ac
Net Residential Area	±47.4 ac
Single Family Area	±23.1 ac
Single Family Homes	44
Single Family Density	±1.90 du/ac
Detached Condo Area	±24.3 ac
Detached Condo Homes	91
Detached Condo Density	±3.7 du/ac
Total Units/Lots	135
Gross Density	±2.72 du/ac
Off Street Parking	23 Total Spaces

*Note: Churchman Road ROW is under design by the City of Dublin and is subject to change.

GRAPHIC SCALE

0 50 100 200

1 inch = 100 feet

REVISIONS

MARK	DATE	DESCRIPTION

SCHOTTENSTEIN HOMES

CITY OF DUBLIN, FRANKLIN COUNTY, OHIO
PRELIMINARY DEVELOPMENT PLAN
FOR
BALLANTRAE WOODS
SITE PLAN

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

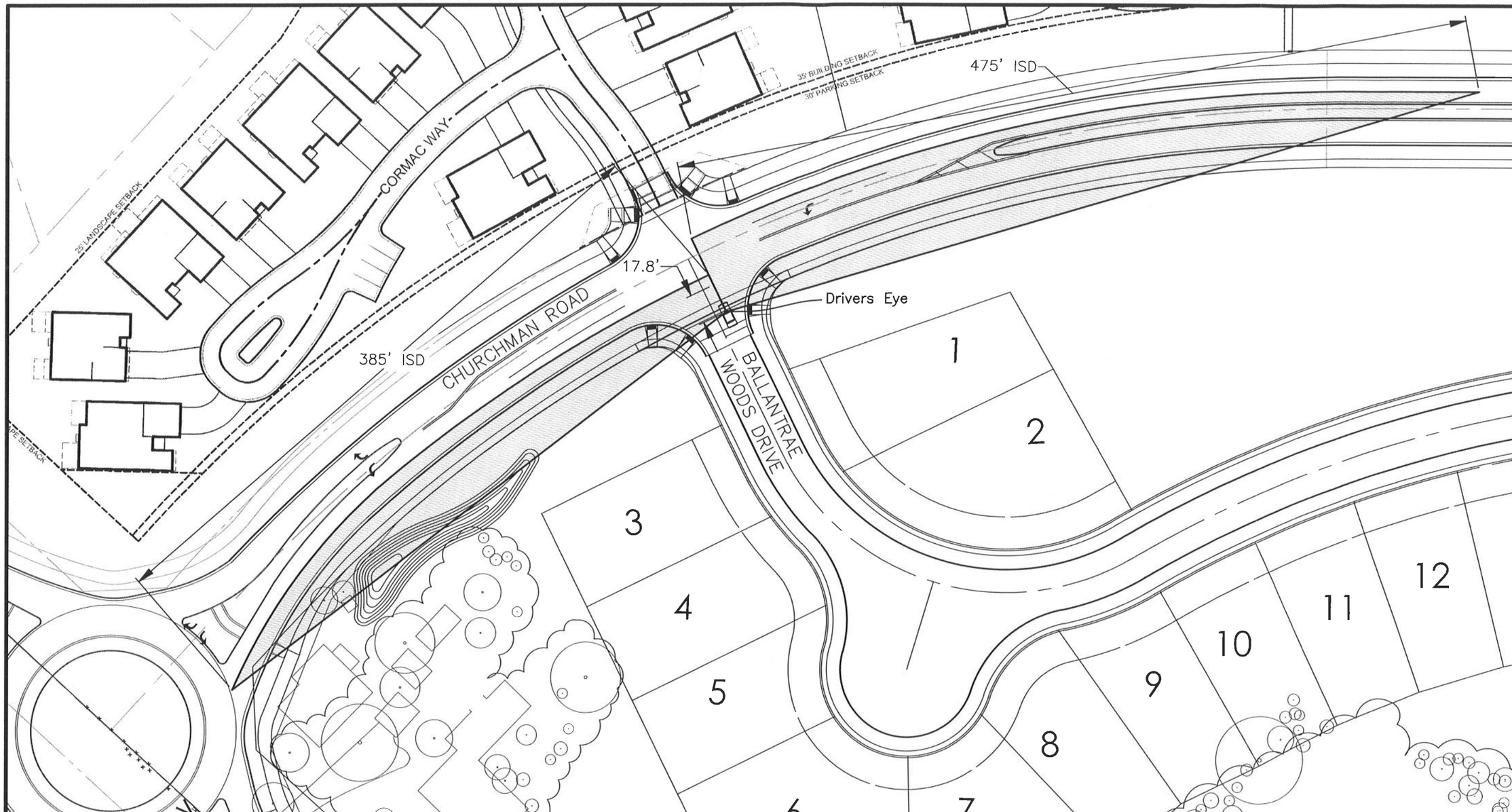
DATE
APRIL 16, 2015

SCALE
1" = 100'

JOB NO.
20140749

SHEET
4 /18

\\emhdata01\project01\20140749\Dwg\04Streets\development plan\04 Site Plan.dwg Last Saved By: aflick, 4/16/2015 10:35 AM Last Printed By: Flick, Andrew, 4/16/2015 2:24 PM (No
XREF)



Scale: Horizontal: 1"=60'

Note: Posted Speed = 35 Mph (Design Speed 40 mph)
No Sight Obstructions Should be Constructed in the Shaded Area

GRAPHIC SCALE

60 0 30 60

1 inch = 60 ft

Date: May 20, 2015

ISD Drawing: 1 of 3

Job No: 2014-0749

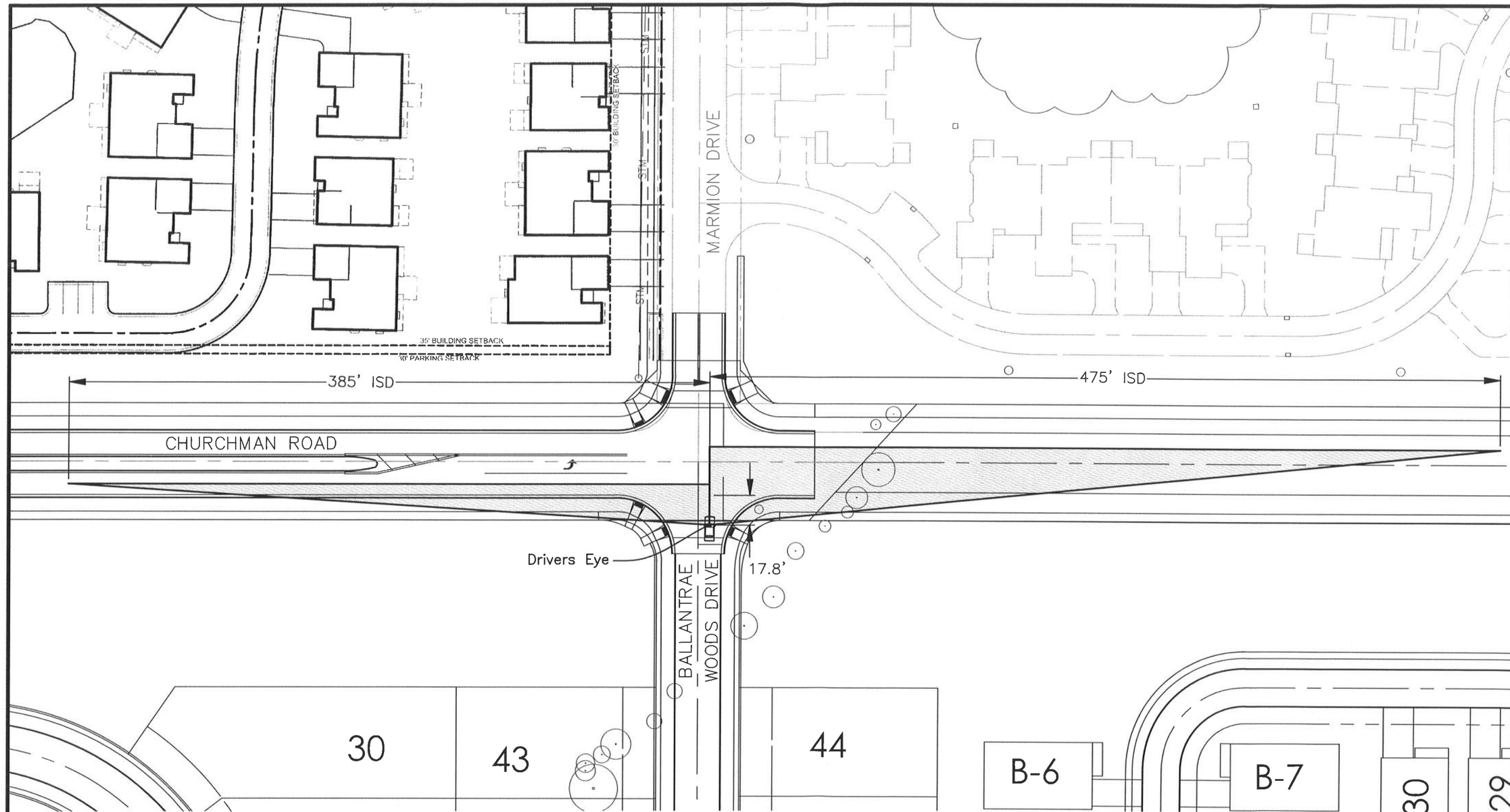
Dublin, Ohio

CHURCHMAN ROAD

INTERSECTION SIGHT DISTANCE EXHIBIT
PROPOSED FULL MOVEMENT ACCESS POINT

EMH&T

A legacy of **experience**. A reputation for **excellence**.



Scale: Horizontal: 1"=60'

Note: Posted Speed = 35 Mph (Design Speed 40 mph)
No Sight Obstructions Should be Constructed in the Shaded Area

GRAPHIC SCALE

60 0 30 60

1 inch = 60 ft

Date: May 20, 2015

ISD Drawing: 2 of 3

Job No: 2014-0749

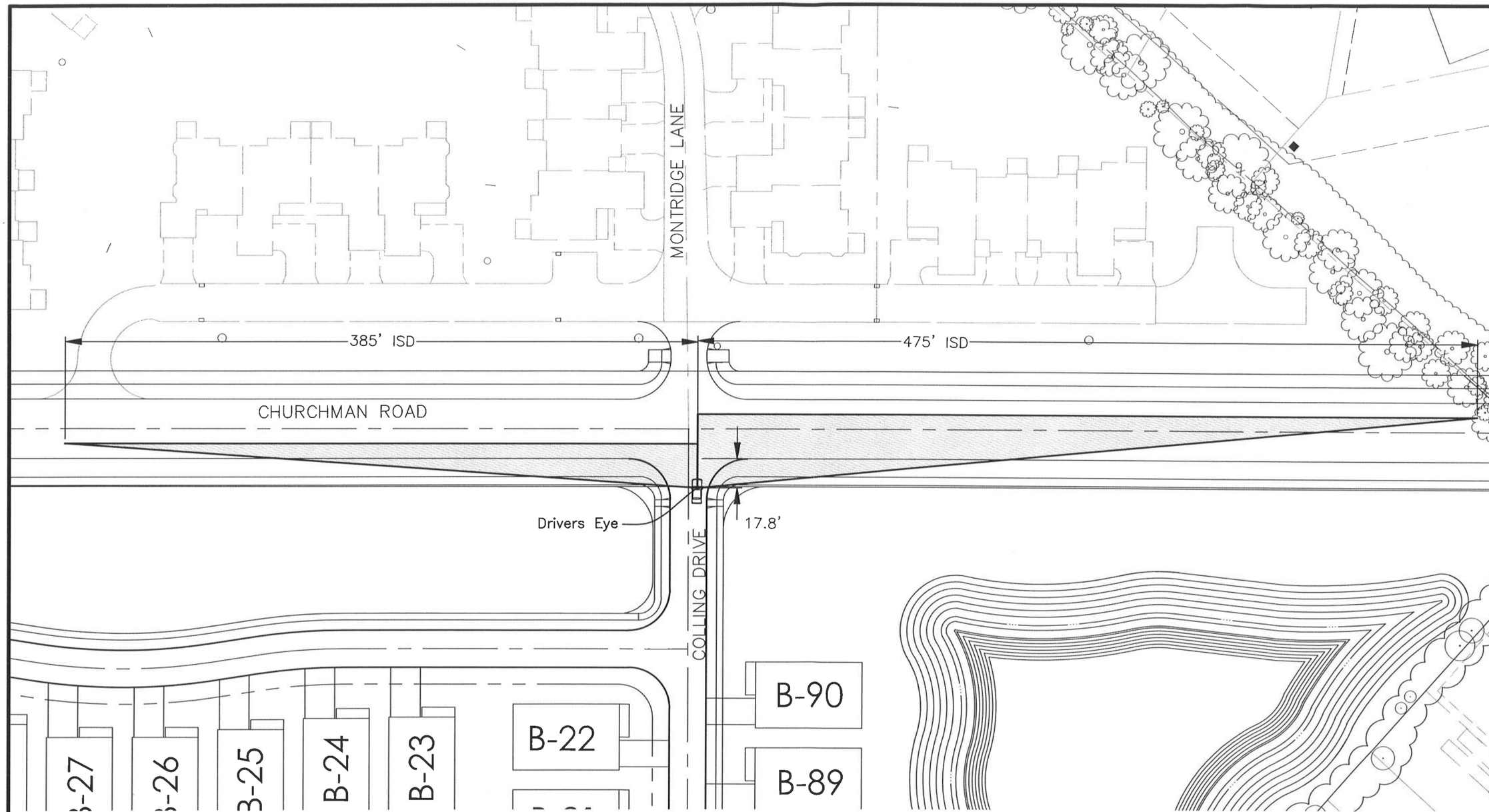
Dublin, Ohio

CHURCHMAN ROAD

INTERSECTION SIGHT DISTANCE EXHIBIT
PROPOSED FULL MOVEMENT ACCESS POINT

EMH&T

A legacy of **experience**. A reputation for **excellence**.



Scale: Horizontal: 1"=60'

Note: Posted Speed = 35 Mph (Design Speed 40 mph)
No Sight Obstructions Should be Constructed in the Shaded Area

GRAPHIC SCALE

60 0 30 60

1 inch = 60 ft

Date: May 20, 2015

ISD Drawing: 3 of 3

Job No: 2014-0749

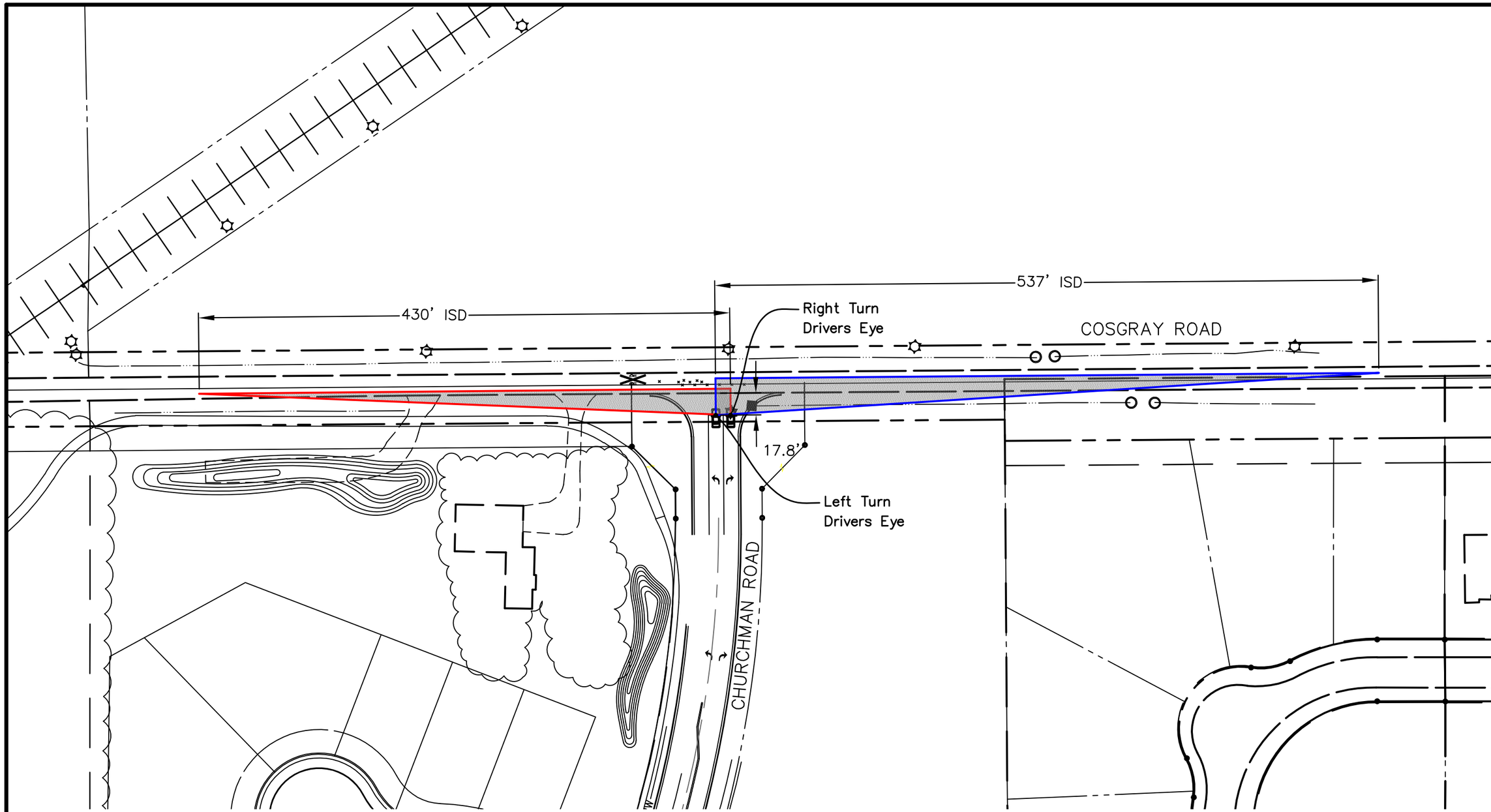
Dublin, Ohio

CHURCHMAN ROAD

INTERSECTION SIGHT DISTANCE EXHIBIT
PROPOSED FULL MOVEMENT ACCESS POINT

EMH&T

A legacy of **experience**. A reputation for **excellence**.



Scale: Horizontal: 1"=80'

Note: Posted Speed = 45 Mph (Design Speed 50 mph)
No Sight Obstructions Should be Constructed in the Shaded Area

GRAPHIC SCALE

60 0 30 60

1 inch = 60 ft

Date: May 20, 2015

ISD Drawing: 4 of 4

Job No: 2014-0749

Dublin, Ohio

CHURCHMAN ROAD AT COSGRAY ROAD

INTERSECTION SIGHT DISTANCE EXHIBIT
PROPOSED FULL MOVEMENT ACCESS POINT

EMH&T

A legacy of **experience**. A reputation for **excellence**.

APPENDIX A
CORRESPONDENCE
(MOU and Comments)

EMH&T
Engineers, Surveyors, Planners, Scientists

January 13, 2015

Tina Wawszkiewicz, PE
City of Dublin, Engineering
5800 Shier-Rings Rd
Dublin, OH 43016

Subject: Liggett Tract TIS
Revised Memorandum of Understanding

Dear Ms. Wawszkiewicz,

The following summarizes our understanding of the scope of work for the traffic impact study discussed during our October 22, 2014 project initiation conference call as well as addressing previous Memorandum of Understanding (MOU) review comments:

Proposed Development
The proposed development is located on the north side of Rings Road, east of Cosgray Road and along the east side of the existing CSX Transportation railroad tracks. The project site is planned to develop with a mix of condominiums and single family dwelling units with a maximum number of total units not to exceed 141lots. Three access points are planned to serve the site that will all connect along Churchman Road north of Rings Road.

Intersections to Analyze
The following intersections will be included in the project study area

- Rings Road/Cosgray Road
- Rings Road/Eiterman Road
- Rings Road/Churchman Road
- Rings Road/Avery Road
- Churchman Road/Site Drive(s)
- Cosgray Road/Churchman Road

Data Collection
Manual turning movement volume counts previously performed by EMH&T personnel at the Rings Road/Cosgray Road and Rings Road/Eiterman Road intersections will be utilized. Likewise, count data at the Rings Road/Avery Road from EMH&T and City personnel will be used in the study. Heavy vehicles were counted separately during these counts and have been listed separately on the count summary sheets. Copies of all count data have been attached. Previous traffic volume data will be increased to opening and horizon year conditions based on previously accepted growth rates discussed with Dublin personnel and documented in the Lare Tract MOU. The Lare

Tract is now referred to as the Links at Ballantrae. Crash data for the study area will not be obtained or analyzed as part of this study.

Trip Generation

Site generated trip ends will be forecast using data and methodology contained in Trip Generation 9th Edition (Institute of Transportation Engineers, 2012). Morning and afternoon peak hour traffic volumes will be estimated using trip generation rates for Land Use Code 210 (Single Family-Detached Housing). Even though the mix of residential units includes single family and condominium units, all trip generation will be based on the higher single family data. The proposed development is expected to include a combination of no more than 141 units that is estimated to generate 108 external trips in the morning peak hour (27 entering, 81 exiting) and 143 external trips in the afternoon peak hour (90 entering, 53 exiting). Detailed trip generation calculations are included in the table below for reference:

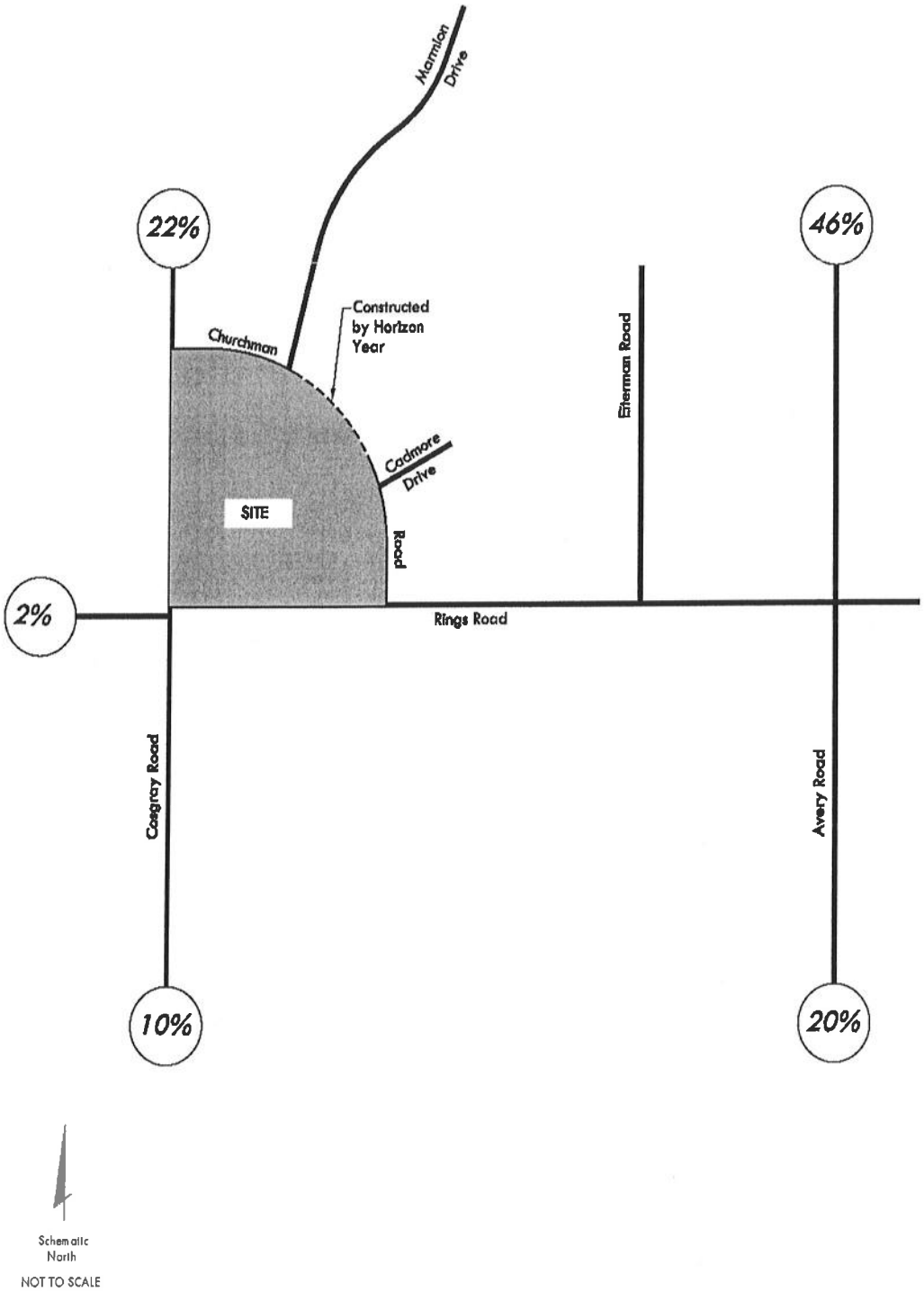
Land Use	Square Feet or Units	ITE Code	Time Period	ITE Formula	Total Trips	Trips Entering	Trips Exiting
Single Family - Detached	141 units	210	ADT	Ln(T)=0.92Ln(x)+2.72	1,442	721	721
			AM Peak	T=0.70(x)+9.74	108	27	81
			PM Peak	Ln(T)=0.90Ln(x)+0.51	143	90	53

Trip Distribution

Site generated traffic volumes will be assigned to the adjacent street network according to the distribution used in the Lare Tract Traffic Study published in 2013. This distribution is illustrated in **Figure 1** below. All trips will be assigned to the adjacent street network via Churchman Road to the adjacent street network including Cosgray Road andRings Road. Some site generated trips may use adjacent residential streets opposite Churchman Road but all site traffic was assigned to the gateways for simplicity in completing this study.

In the opening year, it is assumed that Churchman Road will be available to serve the Liggett Tract site from Marmion Drive north to Cosgray Road only. All site traffic will be assigned via these connections in the Opening Year only. By the Horizon Year, the full connection and reconstruction of Churchman Road to the south, connecting to Rings Road, is assumed to be in place. Consequently, the Links at Ballantrae site traffic will also be re-assigned in the Opening Year to only the Rings Road intersection via Churchman Road. By the Horizon Year, the full connections and completion of Churchman Road will allow the Links at Ballantrae site traffic to be fully distributed as indicated in the TIS for the Horizon Year.

FIGURE 1: Trip Distribution



Traffic Volume Projections

Detailed traffic volume calculations are attached illustrating the development of 2015 and 2025, background and full build traffic volumes. Horizon year traffic volumes were calculated based on the best available information for each intersection within the study area.

- Background horizon year (2025) traffic volumes at the Rings Road/Cosgray Road and Rings Road/Eiterman Road intersections, and 2015 traffic volumes on Rings Road intersections with Cosgray Road, Eiterman Road and Avery Road as well as Cosgray Road/Churchman Drive intersection were developed by expanding 2013 counted traffic volumes with the application of a 3.3 percent growth rate. This growth rate was established by comparing total intersection entering volumes for the years 2008 and 2013 for study area intersections Rings Road/Cosgray Road and Rings Road/Avery Road. Detailed calculations have been provided.

- For 2025 volumes at Avery Road/Rings Road intersection, the calculation of growth rate of each movement was based on comparison of 2030 model (plate A of Avondale Woods TIS) and 2013 Background traffic volumes (in 5300 Avery Road site TIS). These growth rates were applied to 2013 Background traffic volumes and site trips of Avondale Woods as well as 5300 Avery Road site trips were added to obtain 2025 Full Build traffic volumes. It was assumed that the site trips of Links at Ballantrae and current Liggett development were accounted in 2030 model for this intersection. See calculation of attached plates G and G1.

- Horizon year traffic volumes for Churchman Road were taken from the City of Dublin, travel demand model. 2030 travel demand model projections were reduced to 2025 horizon year conditions assuming linear growth from 2016 to 2030. It is assumed (and consistent with Lare Tract study) that approximately 87 percent of traffic volumes forecast for Churchman Road are expected to use the Rings Road/Churchman Road intersection and approximately 13 percent are expected to use the Cosgray Road/Churchman Road intersection.

Traffic Analyses

The following will be conducted as part of the impact analysis:

- Intersection capacity will be evaluated at all study area intersections using the methodologies outlined in the Highway Capacity Manual, with the assistance of the Highway Capacity Software (HCS) for stop-controlled intersections and SIDRA software at roundabouts.

- Turn lane warrants will be evaluated on the through road at stop-controlled intersections in the study area based on graphical solutions provided in the Location and Design Manual (Ohio Department of Transportation, 2014).

- Turn lane storage and deceleration requirements will be recommended for any warranted turn lane improvement based on guidelines published in the Location and Design Manual § 401.6 (Ohio Department of Transportation, 2014).

- An intersection sight distance exhibit will be developed for the proposed Churchman Road connection to Cosgray Road.
- The exhibits of intersection sight distance at the proposed site access intersections with Churchman Road will be included in the preliminary engineering plan to ensure the adequate ISDs will be provided.

Future Area Improvements

City personnel indicated that the first phase of the future Cosgray Road – Rings Road Connector (Churchman Road) will be the northern portion between Cosgray Road and Marmion Drive to be constructed in 2015. Churchman Road will initially connect to Cosgray Road as a stop-controlled, 'T' intersection with only Churchman Road stopping; the City has long range plans to construct a roundabout at Cosgray/Churchman but a future roundabout is assumed to occur beyond the horizon year for this study.

A second phase of construction will extend Churchman Road south to Rings Road by providing the missing portion of the roadway and reconstructing the piece from the Links at Ballantrae entrance south to Rings Road. The City does plan to construct a roundabout at the Churchman Road/Rings Road intersection sometime after 2015 but before the Horizon Year for this study. As a result, the study will analyze a traditional "tee" type intersection at the Cosgray Road connection for both the 2015 and 2025 conditions there. At the Rings Road intersection, Churchman Road will be analyzed as stop-controlled in the 2015 Opening Year and as a roundabout in the 2025 Horizon Year.

Please signify your concurrence with the scope of work outlined herein by signing below and returning this Memorandum of Understanding. If you have any questions or comments, please feel free to contact me directly at (614) 775-4650.

Sincerely,
EVANS, MECHWART, HAMBLETON & TILTON, INC.

Douglas A. Bender, PE, PTOE
Senior Traffic Engineer

ACCEPTANCE AND APPROVAL OF MEMORANDUM OF UNDERSTANDING

By: *Tina Wawszkiewicz, PE*

Date: 1/13/2015

City of Dublin

Engineering
5800 Shier Rings Road • Dublin, OH 43016-1236
Phone: 614-410-4600 • Fax: 614-410-4699

Memo

To: Doug Bender, P.E., PTOE

cc: Brent Welch – Franklin County Engineer's Office

From: Tina Wawszkiewicz, P.E.

Date: April 24, 2015

Re: Ballantrae Woods (Liggett Tract) - Traffic Impact Study Review Comments

Thank you for submitting the traffic impact study for the proposed Ballantrae Woods development. We have reviewed the referenced document dated February 13, 2015 and have the following comments:

1. Please include Franklin County Engineer's Office on the TIS update and review, as they control the east leg of Rings Road at the Cosgray Road intersection.
2. Please calculate the turn lane lengths needed on Churchman Road for all three site drives, and compare to the proposed turn lane lengths along Churchman Road.
3. Please add a report cover and table of contents.
4. Please add references to applicable appendices within the body of the report.
5. Please present a graphic within the body of the report summarizing peak hour background, site and total trips at the study intersections for opening day and horizon year traffic.
6. Please note if the 3.3% growth rate is consistent with other studies in the area.
7. Please provide signal warrants and a summary table within the report. Right turn reductions should be calculated according to ODOT standards in the Traffic Engineering Manual. The report should be a standalone document, containing all supporting information.
8. Please review Table 3 Turn Lane Warrant Summary and the supporting paragraph below the table. There are inconsistencies between the table and the text. It also appears there should be at least one more intersection included in the table.
9. Please review the warrant for the Rings Road eastbound left turn lane for Eiterman Road. This does not appear to meet a warrant under the background conditions for 2015.
10. Intersection sight distance must be evaluated at the three proposed site drive intersections with Churchman Road, and at the Cosgray Road and Churchman Road intersection within the traffic impact study. Even though final grading may change as site plans are further developed, visibility needs to be considered to prevent obstructions such as landscaping and entry features for the site are planned. Please note the gap time should include an additional 0.5 seconds, as drivers will need to cross three lanes to make a left turn.

11. Capacity analysis needs to be presented for the existing field conditions (intersection control and number of approach lanes) at each study intersection. The results of the existing conditions with and without site traffic must be presented prior to adding any warranted or mitigating measures.
    - The intersections of Cosgray Road and Rings Road must be analyzed as they exist in the field condition, as two separate intersections.
12. HCS software must be used to evaluate level of service at stop controlled intersections. Synchro is only allowed for evaluating signalized intersections.
13. The "Sidra Standard" method for the level of service calculation is allowable in the Sidra roundabout analysis.
14. At the Rings Road/Cosgray Road intersection, a roundabout solution should be considered as an alternative mitigation to signalization. Please include both options for future intersection control. Coordinate improvement recommendations and analysis with Franklin County Engineer's Office at this intersection, as they control the east leg of Rings Road.
15. In section 5.3.2 Cosgray Road at Churchman Road, please discuss the turn lane warranted with site traffic on opening day.
16. In section 5.3.2 Cosgray Road at Churchman Road, right-of-way needs at this intersection are being coordinated with the public roadway improvements. It appears more area may be needed than shown graphically in the TIS. Please continue to coordinate this effort through final design, and update the text in section 5.3.2 accordingly.
17. In section 5.3.3 Rings Road and Eiterman Road, please discuss the eastbound left turn lane and clarify lane configuration assumptions used for the level of service analysis.
18. The preliminary roundabout lane configuration at the intersection of Avery Road and Rings Road/Cara Road does not include a dedicated southbound right turn lane. The southbound approach is anticipated to provide two through lanes with shared turning movements.
19. Please provide a summary graphic to display the background and site related improvements recommended at each study intersection for opening day and horizon year traffic.
20. Please indicate the north direction on the graphics in appendix C.
21. The Developer may be asked to contribute to offsite transportation improvements based on the results of the updated study.

Please submit three hard copies and a single file electronic PDF of the updated study to Aaron Stanford, P.E. Please send one hard copy and an electronic copy to the Franklin County Engineer's Office. Thank you for your efforts on this project.

APPENDIX B
DATA COLLECTED
(Material from Lare Tract TIS)

EMH&T

5500 New Albany Rd.
Columbus, OH 43054
emht.com

File Name : Avery-Rings AM
Site Code : 00000000
Start Date : 1/9/2013
Page No : 1

Groups Printed- Cars - Trucks

	AVERY Southbound					RINGS Westbound					AVERY Northbound					RINGS Eastbound					
Start Time	Left	Thru	Right	Peds	App Total	Left	Thru	Right	Peds	App Total	Left	Thru	Right	Peds	App Total	Left	Thru	Right	Peds	App Total	Int. Total
07:00 AM	1	54	11	0	66	0	0	1	0	1	5	90	0	0	95	34	0	15	0	49	211
07:15 AM	0	85	8	0	93	0	0	0	0	0	6	115	0	0	121	35	0	32	0	67	281
07:30 AM	0	87	9	0	96	0	0	2	0	2	8	143	1	0	152	42	0	10	0	52	302
07:45 AM	1	71	11	0	83	1	0	2	0	3	11	161	1	0	173	41	0	13	0	54	313
Total	2	297	39	0	338	1	0	5	0	6	30	509	2	0	541	152	0	70	0	222	1107
08:00 AM	1	67	9	0	77	1	1	1	0	3	5	149	1	0	155	26	0	10	0	36	271
08:15 AM	0	76	9	0	85	0	1	0	0	1	9	149	1	0	159	35	0	13	0	48	293
08:30 AM	0	68	6	0	74	1	0	0	0	1	6	105	1	0	112	34	0	9	0	43	230
08:45 AM	0	45	14	0	59	0	0	0	0	0	11	116	0	0	127	36	0	20	0	56	242
Total	1	256	38	0	295	2	2	1	0	5	31	519	3	0	553	131	0	52	0	183	1036
Grand Total	3	553	77	0	633	3	2	6	0	11	61	1028	5	0	1094	283	0	122	0	405	2143
Apprch %	0.5	87.4	12.2	0		27.3	18.2	54.5	0		5.6	94	0.5	0		69.9	0	30.1	0		
Total %	0.1	25.8	3.6	0	29.5	0.1	0.1	0.3	0	0.5	2.8	48	0.2	0	51	13.2	0	5.7	0	18.9	
Cars	2	542	74	0	618	2	0	5	0	7	57	1020	2	0	1079	281	0	116	0	396	2100
% Cars	66.7	98	96.1	0	97.6	66.7	0	83.3	0	63.6	93.4	99.2	40	0	98.6	99.3	0	94.3	0	97.8	98
Trucks	1	11	3	0	15	1	2	1	0	4	4	8	3	0	15	2	0	7	0	9	43
% Trucks	33.3	2	3.9	0	2.4	33.3	100	16.7	0	36.4	6.6	0.8	60	0	1.4	0.7	0	5.7	0	2.2	2
7:15-8:15	2	310	37			2	1	5			30	568	3			144	0	65			

Traffic Engineering Services, Inc.
742 Radio Drive
Lewis Center, OH 43035
(740) 549-0070

File Name : Avery Rd & Rings Rd-Cara Rd - PM Peak
Site Code : 00000619
Start Date : 6/19/2012
Page No : 1

Groups Printed- All Vehicles

	Avery Road Southbound				Cara Road Westbound				Avery Road Northbound				Rings Road Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Factor	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
04:00 PM	0	84	28	112	0	0	1	1	12	56	1	69	9	0	6	15	197
04:15 PM	3	131	44	178	1	0	3	4	15	73	1	89	13	0	8	21	292
04:30 PM	0	148	40	188	0	0	0	0	7	59	0	66	8	1	5	14	268
04:45 PM	3	164	58	225	0	0	2	2	10	86	2	100	6	1	8	15	342
Total	6	527	170	703	1	0	6	7	44	275	4	324	36	2	27	65	1099
05:00 PM	9	197	58	264	2	0	2	4	11	69	2	82	5	1	7	13	363
05:15 PM	12	224	64	300	6	2	4	12	14	93	12	119	9	4	10	23	454
05:30 PM	8	194	46	249	1	2	2	5	16	79	9	104	7	1	12	20	378
05:45 PM	4	167	52	223	1	0	4	5	7	82	9	98	6	2	11	19	345
Total	34	782	220	1036	10	4	12	26	48	323	32	403	27	8	40	75	1540
Grand Total	40	1309	390	1739	11	4	18	33	92	599	36	727	63	10	67	140	2639
Apprch %	2.3	75.3	22.4		33.3	12.1	54.5		12.7	82.4	5.0		45.0	7.1	47.9		
Total %	1.5	49.6	14.8	65.9	0.4	0.2	0.7	1.3	3.5	22.7	1.4	27.5	2.4	0.4	2.5	5.3	

	Avery Road Southbound				Cara Road Westbound				Avery Road Northbound				Rings Road Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Intersection	05:00 PM																
Volume	34	782	220	1036	10	4	12	26	48	323	32	403	27	8	40	75	1540
Percent	3.3	75.5	21.2		38.5	15.4	46.2		11.9	80.1	7.9		36.0	10.7	53.3		
05:15 Volume	12	224	64	300	6	2	4	12	14	93	12	119	9	4	10	23	454
Peak Factor																	0.848
High Int.	05:15 PM				05:15 PM				05:15 PM				05:15 PM				
Volume	12	224	64	300	6	2	4	12	14	93	12	119	9	4	10	23	
Peak Factor				0.863				0.542				0.847				0.815	

EMH&T

5500 New Albany Rd.
Columbus, OH 43054
emht.com

File Name : rings-eiterman
Site Code : 00000000
Start Date : 1/9/2013
Page No : 1

Groups Printed- Cars - Trucks

	EITERMAN Southbound					RINGS Westbound					EITERMAN Northbound					RINGS Eastbound					
Start Time	Left	Thru	Right	Peds	App Total	Left	Thru	Right	Peds	App Total	Left	Thru	Right	Peds	App Total	Left	Thru	Right	Peds	App Total	Int. Total
04:00 PM	4	0	6	0	10	0	45	1	0	46	0	0	0	0	0	3	13	0	0	16	72
04:15 PM	10	0	7	0	17	0	39	8	0	47	0	0	0	0	0	4	13	0	0	17	81
04:30 PM	5	0	8	0	13	0	35	3	0	38	0	0	0	0	0	5	12	0	0	17	68
04:45 PM	4	0	9	0	13	0	42	5	0	47	0	0	0	0	0	4	14	0	0	18	78
Total	23	0	30	0	53	0	161	17	0	178	0	0	0	0	0	16	52	0	0	68	299
05:00 PM	7	0	13	0	20	0	68	10	0	78	0	0	0	0	0	6	11	0	0	17	115
05:15 PM	7	0	15	0	22	0	58	7	0	65	0	0	0	0	0	7	10	0	0	17	104
05:30 PM	4	0	10	0	14	0	51	13	0	64	0	0	0	0	0	5	8	0	0	13	91
05:45 PM	9	0	11	0	20	0	36	5	0	41	0	0	0	0	0	4	10	0	0	14	75
Total	27	0	49	0	76	0	213	35	0	248	0	0	0	0	0	22	39	0	0	61	385
*** BREAK ***																					
07:00 AM	8	0	6	0	14	0	18	6	0	24	0	0	0	0	0	7	60	0	0	67	105
07:15 AM	14	0	4	0	18	0	21	4	0	25	0	0	0	0	0	13	84	0	0	97	140
07:30 AM	6	0	5	0	11	0	18	10	0	28	0	0	0	0	0	30	47	0	0	77	116
07:45 AM	8	0	5	0	13	0	13	6	0	19	0	0	0	0	0	26	26	0	0	52	84
Total	36	0	20	0	56	0	70	26	0	96	0	0	0	0	0	76	217	0	0	293	445
08:00 AM	4	0	4	0	8	0	13	7	0	20	0	0	0	0	0	24	35	0	0	59	87
08:15 AM	3	0	2	0	5	0	10	5	0	15	0	0	0	0	0	10	30	0	0	40	60
08:30 AM	3	0	3	0	6	0	13	13	0	26	0	0	0	0	0	6	40	0	0	46	78
08:45 AM	33	0	13	0	46	0	18	39	0	57	0	0	0	0	0	18	34	0	0	52	155
Total	43	0	22	0	65	0	54	64	0	118	0	0	0	0	0	58	139	0	0	197	380
Grand Total	129	0	121	0	250	0	498	142	0	640	0	0	0	0	0	172	447	0	0	619	1509
Apprch %	51.6	0	48.4	0		0	77.8	22.2	0		0	0	0	0		27.8	72.2	0	0		
Total %	8.5	0	8	0	16.6	0	33	9.4	0	42.4	0	0	0	0	0	11.4	29.6	0	0	41	
Cars	124	0	119	0	243	0	487	142	0	629	0	0	0	0	0	165	439	0	0	604	1476
% Cars	96.1	0	98.3	0	97.2	0	97.8	100	0	98.3	0	0	0	0	0	95.9	98.2	0	0	97.6	97.8
Trucks	5	0	2	0	7	0	11	0	0	11	0	0	0	0	0	7	8	0	0	15	33
% Trucks	3.9	0	1.7	0	2.8	0	2.2	0	0	1.7	0	0	0	0	0	4.1	1.8	0	0	2.4	2.2
7:15-8:15	32	0	18			0	65	27			0	0	0			93	192	0			

EMH&T

5500 New Albany Rd.
Columbus, OH 43054
emht.com

File Name : Rings-Cosgray
Site Code : 00000000
Start Date : 1/9/2013
Page No : 1

Groups Printed- Cars - Trucks

	COSGRAY Southbound					RINGS Westbound					COSGRAY Northbound					RINGS Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
07:00 AM	1	46	2	0	49	12	3	2	0	17	6	92	24	0	122	7	13	18	0	38	226
07:15 AM	2	24	3	0	29	13	2	2	0	17	4	107	37	0	148	5	17	6	0	28	222
07:30 AM	3	49	1	0	53	10	5	0	0	15	5	147	53	0	205	10	18	13	0	41	314
07:45 AM	1	35	1	0	37	10	2	2	0	14	5	118	37	0	160	11	17	9	0	37	248
Total	7	154	7	0	168	45	12	6	0	63	20	464	151	0	635	33	65	46	0	144	1010
08:00 AM	3	31	1	0	35	7	4	1	0	12	5	95	28	0	128	4	11	13	0	28	203
08:15 AM	2	28	1	0	31	7	0	0	0	7	4	72	30	0	106	4	10	6	0	20	164
08:30 AM	3	26	0	0	29	10	0	1	0	11	2	59	30	0	91	9	8	9	0	26	157
08:45 AM	2	20	0	0	22	16	5	3	0	24	3	56	30	0	89	4	9	5	0	18	153
Total	10	105	2	0	117	40	9	5	0	54	14	282	118	0	414	21	38	33	0	92	677
*** BREAK ***																					
04:00 PM	2	67	8	0	77	24	12	2	0	38	11	47	10	0	68	3	1	10	0	14	197
04:15 PM	0	92	13	0	105	29	16	3	0	48	16	50	10	0	76	3	3	7	0	13	242
04:30 PM	3	87	11	0	101	20	10	0	0	30	8	48	11	0	67	3	5	8	0	16	214
04:45 PM	2	110	4	0	116	25	15	7	0	47	11	64	18	0	93	1	5	8	0	14	270
Total	7	356	36	0	399	98	53	12	0	163	46	209	49	0	304	10	14	33	0	57	923
05:00 PM	3	115	8	0	126	42	16	2	0	60	21	39	8	0	68	1	0	9	0	10	264
05:15 PM	1	142	9	0	152	53	20	6	0	79	17	60	6	0	83	4	4	6	0	14	328
05:30 PM	2	126	10	0	138	38	10	7	0	55	22	60	11	0	93	1	2	12	0	15	301
05:45 PM	1	130	10	0	141	41	14	2	0	57	18	49	12	0	79	5	1	5	0	11	288
Total	7	513	37	0	557	174	60	17	0	251	78	208	37	0	323	11	7	32	0	50	1181
Grand Total	31	1128	82	0	1241	357	134	40	0	531	158	1163	355	0	1676	75	124	144	0	343	3791
Apprch %	2.5	90.9	6.6	0		67.2	25.2	7.5	0		9.4	69.4	21.2	0		21.9	36.2	42	0		
Total %	0.8	29.8	2.2	0	32.7	9.4	3.5	1.1	0	14	4.2	30.7	9.4	0	44.2	2	3.3	3.8	0	9	
Cars	28	1110	81	0	1219	352	132	38	0	522	156	1148	351	0	1655	75	124	142	0	341	3737
% Cars	90.3	98.4	98.8	0	98.2	98.6	98.5	95	0	98.3	98.7	98.7	98.9	0	98.7	100	100	98.6	0	99.4	98.6
Trucks	3	18	1	0	22	5	2	2	0	9	2	15	4	0	21	0	0	2	0	2	54
% Trucks	9.7	1.6	1.2	0	1.8	1.4	1.5	5	0	1.7	1.3	1.3	1.1	0	1.3	0	0	1.4	0	0.6	1.4
7:15-8:15	9	139	6			40	13	5			19	467	155			30	63	41			

EMH&T, Inc.
5500 New Albany Rd
Columbus, Ohio 43054
614-775-4500

File Name : Rings_Cosgray
Site Code : 00000000
Start Date : 2/26/2008
Page No : 1

Groups Printed- Cars - Trucks

	Cosgray Rd Southbound				Rings Rd Westbound				Cosgray Rd Northbound				Rings Rd Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	5	27	2	34	3	1	1	5	6	73	15	94	2	10	10	22	155
07:15 AM	3	29	0	32	3	3	0	6	2	66	18	86	5	15	12	32	156
07:30 AM	2	27	1	30	6	2	0	8	5	81	28	114	1	13	8	22	174
07:45 AM	2	27	0	29	3	2	1	6	5	127	37	169	2	17	5	24	228
Total	12	110	3	125	15	8	2	25	18	347	98	463	10	55	35	100	713
08:00 AM	2	26	2	30	6	2	2	10	5	77	21	103	3	8	6	17	160
08:15 AM	0	25	2	27	3	2	1	6	2	75	18	95	3	4	6	13	141
08:30 AM	2	33	3	38	3	1	3	7	1	82	17	100	1	4	6	11	156
08:45 AM	6	17	1	24	4	2	3	9	1	58	18	77	5	8	7	20	130
Total	10	101	8	119	16	7	9	32	9	292	74	375	12	24	25	61	587
*** BREAK ***																	
04:00 PM	0	82	4	86	11	9	3	23	5	48	7	60	1	0	3	4	173
04:15 PM	1	67	4	72	13	8	1	22	9	32	3	44	3	2	7	12	150
04:30 PM	4	81	8	93	17	12	1	30	9	35	3	47	2	3	4	9	179
04:45 PM	0	81	3	84	19	10	6	35	7	34	10	51	0	1	5	6	176
Total	5	311	19	335	60	39	11	110	30	149	23	202	6	6	19	31	678
05:00 PM	0	99	8	107	24	12	1	37	11	38	3	52	1	3	8	12	208
05:15 PM	1	106	5	112	34	14	0	48	15	34	5	54	1	3	9	13	227
05:30 PM	0	82	1	83	20	7	0	27	5	27	5	37	1	4	4	9	156
05:45 PM	2	58	2	62	11	9	5	25	9	38	13	60	1	0	10	11	158
Total	3	345	16	364	89	42	6	137	40	137	26	203	4	10	31	45	749
Grand Total	30	867	46	943	180	96	28	304	97	925	221	1243	32	95	110	237	2727
Apprch %	3.2	91.9	4.9		59.2	31.6	9.2		7.8	74.4	17.8		13.5	40.1	46.4		
Total %	1.1	31.8	1.7	34.6	6.6	3.5	1	11.1	3.6	33.9	8.1	45.6	1.2	3.5	4	8.7	
Cars	26	851	43	920	177	96	28	301	93	901	214	1208	31	93	104	228	2657
% Cars	86.7	98.2	93.5	97.6	98.3	100	100	99	95.9	97.4	96.8	97.2	96.9	97.9	94.5	96.2	97.4
Trucks	4	16	3	23	3	0	0	3	4	24	7	35	1	2	6	9	70
% Trucks	13.3	1.8	6.5	2.4	1.7	0	0	1	4.1	2.6	3.2	2.8	3.1	2.1	5.5	3.8	2.6

7:15-8:15	9	109	3	18	9	3	17	351	104	11	53	31
4:30-5:30	5	367	24	94	48	8	42	141	21	4	10	26

City of Dublin
Engieering
5800 Shier Rings Road
Dublin, Ohio 43016

File Name : AveryringsAM 92706
Site Code : 00000000
Start Date : 9/27/2006
Page No : 1

Groups Printed- Cars - Trucks

	AVERY From North					RINGS From East					AVERY From South					RINGS From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	5	49	1	0	55	2	0	2	0	4	0	79	1	0	80	22	1	28	0	51	190
07:15 AM	7	61	0	0	68	3	0	1	0	4	3	84	4	0	91	21	0	40	0	61	224
07:30 AM	8	53	0	0	61	2	0	1	0	3	0	142	7	0	149	15	0	55	0	70	283
07:45 AM	8	57	0	0	65	1	0	0	0	1	1	154	5	0	160	5	1	53	0	59	285
Total	28	220	1	0	249	8	0	4	0	12	4	459	17	0	480	63	2	176	0	241	982
08:00 AM	5	65	0	0	70	0	0	1	0	1	1	108	4	0	113	17	2	30	0	49	233
08:15 AM	6	41	0	0	47	2	0	1	0	3	1	77	3	0	81	8	0	34	0	42	173
08:30 AM	8	65	1	0	74	0	0	1	0	1	1	88	8	0	97	10	0	30	0	40	212
08:45 AM	10	39	0	0	49	2	0	0	0	2	0	109	4	0	113	13	0	24	0	37	201
Total	29	210	1	0	240	4	0	3	0	7	3	382	19	0	404	48	2	118	0	168	819
Grand Total	57	430	2	0	489	12	0	7	0	19	7	841	36	0	884	111	4	294	0	409	1801
Apprch %	11.7	87.9	0.4	0		63.2	0	36.8	0		0.8	95.1	4.1	0		27.1	1	71.9	0		
Total %	3.2	23.9	0.1	0	27.2	0.7	0	0.4	0	1.1	0.4	46.7	2	0	49.1	6.2	0.2	16.3	0	22.7	
Cars	56	424	2	0	482	12	0	7	0	19	7	840	36	0	883	111	4	292	0	407	1791
% Cars	98.2	98.6	100	0	98.6	100	0	100	0	100	100	99.9	100	0	99.9	100	100	99.3	0	99.5	99.4
Trucks	1	6	0	0	7	0	0	0	0	0	0	1	0	0	1	0	0	2	0	2	10
% Trucks	1.8	1.4	0	0	1.4	0	0	0	0	0	0	0.1	0	0	0.1	0	0	0.7	0	0.5	0.6

	AVERY From North					RINGS From East					AVERY From South					RINGS From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	7	61	0	0	68	3	0	1	0	4	3	84	4	0	91	21	0	40	0	61	224
07:30 AM	8	53	0	0	61	2	0	1	0	3	0	142	7	0	149	15	0	55	0	70	283
07:45 AM	8	57	0	0	65	1	0	0	0	1	1	154	5	0	160	5	1	53	0	59	285
08:00 AM	5	65	0	0	70	0	0	1	0	1	1	108	4	0	113	17	2	30	0	49	233
Total Volume	28	236	0	0	264	6	0	3	0	9	5	488	20	0	513	58	3	178	0	239	1025
% App. Total	10.6	89.4	0	0		66.7	0	33.3	0		1	95.1	3.9	0		24.3	1.3	74.5	0		
PHF	.875	.908	.000	.000	.943	.500	.000	.750	.000	.563	.417	.792	.714	.000	.802	.690	.375	.809	.000	.854	.899

Gary
Wed

City of Dublin
Engieering
5800 Shier Rings Road
Dublin, Ohio 43016

File Name : AvryringsPM 92706
Site Code : 00000000
Start Date : 9/27/2006
Page No : 1

Groups Printed- Cars - Trucks

	AVERY From North					RINGS From East					AVERY From South					RINGS From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	36	107	2	0	145	1	0	1	0	2	0	67	13	0	80	6	0	7	0	13	240
04:15 PM	26	125	1	0	152	0	0	0	0	0	1	66	14	0	81	7	0	17	0	24	257
04:30 PM	38	177	1	0	216	0	1	0	0	1	0	79	10	0	89	9	0	12	0	21	327
04:45 PM	39	182	1	0	222	0	0	3	0	3	0	84	12	0	96	14	0	17	0	31	352
Total	139	591	5	0	735	1	1	4	0	6	1	296	49	0	346	36	0	53	0	89	1176
05:00 PM	54	242	1	0	297	1	0	1	0	2	1	118	13	0	132	5	0	15	0	20	451
05:15 PM	52	205	11	0	268	1	1	0	0	2	1	90	10	0	101	8	1	19	0	28	399
05:30 PM	32	167	4	0	203	0	0	2	0	2	1	54	8	0	63	7	1	10	0	18	286
05:45 PM	33	141	3	0	177	0	0	2	0	2	1	65	5	0	71	14	0	15	0	29	279
Total	171	755	19	0	945	2	1	5	0	8	4	327	36	0	367	34	2	59	0	95	1415
Grand Total	310	1346	24	0	1680	3	2	9	0	14	5	623	85	0	713	70	2	112	0	184	2591
Apprch %	18.5	80.1	1.4	0		21.4	14.3	64.3	0		0.7	87.4	11.9	0		38	1.1	60.9	0		
Total %	12	51.9	0.9	0	64.8	0.1	0.1	0.3	0	0.5	0.2	24	3.3	0	27.5	2.7	0.1	4.3	0	7.1	
Cars	310	1341	24	0	1675	3	2	9	0	14	5	621	85	0	711	65	2	112	0	179	2579
% Cars	100	99.6	100	0	99.7	100	100	100	0	100	100	99.7	100	0	99.7	92.9	100	100	0	97.3	99.5
Trucks	0	5	0	0	5	0	0	0	0	0	0	2	0	0	2	5	0	0	0	5	12
% Trucks	0	0.4	0	0	0.3	0	0	0	0	0	0	0.3	0	0	0.3	7.1	0	0	0	2.7	0.5

	AVERY From North					RINGS From East					AVERY From South					RINGS From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	38	177	1	0	216	0	[illegible]	0	0	1	0	79	10	0	89	9	0	12	0	21	327
04:45 PM	39	182	1	0	222	0	0	[illegible]	0	[illegible]	0	84	12	0	96	[illegible]	0	17	0	31	352
05:00 PM	54	242	1	0	297	1	0	1	0	2	1	118	13	0	132	5	0	15	0	20	451
05:15 PM	52	205	11	0	268	1	1	0	0	2	1	90	10	0	101	8	1	19	0	28	399
Total Volume	183	806	14	0	1003	2	2	4	0	8	2	371	45	0	418	36	1	63	0	100	1529
% App. Total	18.2	80.4	1.4	0		25	25	50	0		0.5	88.8	10.8	0		36	1	63	0		
PHF	.847	.833	.318	.000	.864	.500	.500	.333	.000	.667	.500	.786	.865	.000	.792	.643	.250	.829	.000	.806	.848

Lare Tract
Traffic Impact Study
Growth Rate Calculation

2008 Interpolated Traffic Volumes — AM Peak Hour

		Avery	Road			
				6	RT	
RT	TH	LT		0	TH	
31	257	1		3	LT	Rings Road
	LT	168		23	511	4
	TH	2		LT	TH	RT
	RT	60				

2013 Counted Traffic Volumes — AM Peak Hour

		Avery	Road			
				5	RT	
RT	TH	LT		1	TH	
37	310	2		2	LT	Rings Road
	LT	144		30	568	3
	TH	0		LT	TH	RT
	RT	65				

2008 Counted Traffic Volumes — AM Peak Hour

		Cosgray	Road			
				3	RT	
RT	TH	LT		9	TH	
3	109	9		18	LT	Rings Road
	LT	11		17	351	104
	TH	53		LT	TH	RT
	RT	31				

2013 Counted Traffic Volumes — AM Peak Hour

		Cosgray	Road			
				6	RT	
RT	TH	LT		12	TH	
7	154	7		45	LT	Rings Road
	LT	33		20	464	151
	TH	65		LT	TH	RT
	RT	46				

2008 Interpolated Traffic Volumes — PM Peak Hour

		Avery	Road			
				5	RT	
RT	TH	LT		3	TH	
194	799	20		6	LT	Rings Road
	LT	53		46	357	11
	TH	3		LT	TH	RT
	RT	37				

2013 Counted Traffic Volumes — PM Peak Hour

		Avery	Road			
				12	RT	
RT	TH	LT		4	TH	
220	782	34		10	LT	Rings Road
	LT	27		48	323	32
	TH	8		LT	TH	RT
	RT	40				

2008 Counted Traffic Volumes — PM Peak Hour

		Cosgray	Road			
				8	RT	
RT	TH	LT		48	TH	
24	367	5		94	LT	Rings Road
	LT	4		42	141	21
	TH	10		LT	TH	RT
	RT	26				

2013 Counted Traffic Volumes — PM Peak Hour

		Cosgray	Road			
				15	RT	
RT	TH	LT		61	TH	
32	454	9		140	LT	Rings Road
	LT	9		57	211	43
	TH	14		LT	TH	RT
	RT	31				

2008 Interpolated Traffic Volumes — AM + PM
2600 =Total Intersection Volume

		Avery	Road			
				11	RT	
RT	TH	LT		3	TH	
225	1056	21		9	LT	Rings Road
	LT	221		69	868	15
	TH	5		LT	TH	RT
	RT	97				

2013 Counted Traffic Volumes — AM + PM
2707 =Total Intersection Volume

		Avery	Road			
				17	RT	
RT	TH	LT		5	TH	
257	1092	36		12	LT	Rings Road
	LT	171		78	891	35
	TH	8		LT	TH	RT
	RT	105				

2008 Counted Traffic Volumes — AM + PM
1508 =Total Intersection Volume

		Cosgray	Road			
				11	RT	
RT	TH	LT		57	TH	
27	476	14		112	LT	Rings Road
	LT	15		59	492	125
	TH	63		LT	TH	RT
	RT	57				

2013 Counted Traffic Volumes — AM + PM
2086 =Total Intersection Volume

		Cosgray	Road			
				21	RT	
RT	TH	LT		73	TH	
39	608	16		185	LT	Rings Road
	LT	42		77	675	194
	TH	79		LT	TH	RT
	RT	77				

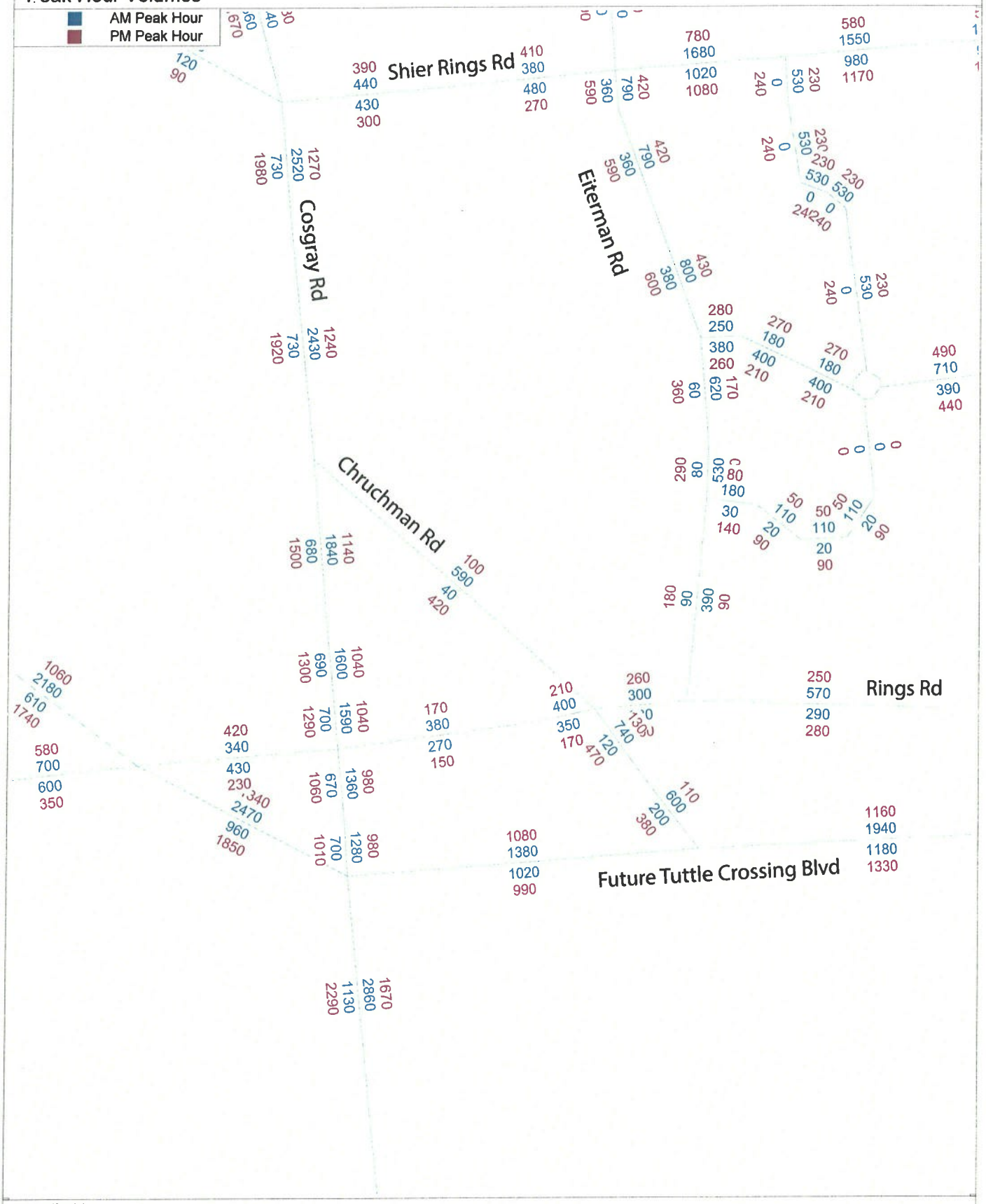
Growth Rate Calculation (2008 to 2013)
Avery/Ring - Cosgray/Rings Average

$$G = \frac{F-E}{EN}$$

F= 4793 Vehicles/Hour in Year 2008
E= 4108 Vehicles/Hour in Year 2002
N= 5 Years

G= 3.3% per year

Dublin Travel Demand Model, Year 2030 Output
Peak Hour Volumes



11/19/2014
S:\Travel Demand Modeling\DublinModel\Base\CommPlanNetworkChangeandTODUpdate\plot.net

(Licensed to City of Dublin, OH)

From Lare Tract TIS

2013 Count Volumes																
	Cosgray								Rings							
Hour	NBLT	NBTH	NBRT	NB Total	SBLT	SBTH	SBRT	SB Total	EBLT	EBTH	EBRT	EB Total	WBLT	WBTH	WBRT	WB Total
6-7 AM	19	467	155	641	6	139	9	154	30	63	41	134	40	13	5	58
7-8 AM	18	436	145	599	6	130	8	144	28	59	38	125	37	12	5	54
8-9 AM	12	291	97	400	4	87	6	96	19	39	26	84	25	8	3	36
9-10 AM	9	224	74	307	3	67	4	74	14	30	20	64	19	6	2	28
10-11 AM	12	293	97	403	4	87	6	97	19	40	26	84	25	8	3	36
11-12 NOON	13	314	104	432	4	94	6	104	20	42	28	90	27	9	3	39
12-1 PM	35	94	17	146	3	231	17	251	5	3	14	23	78	27	8	113
1-2 PM	34	91	16	142	3	225	16	245	5	3	14	22	76	26	7	110
2-3 PM	49	130	23	202	4	320	23	348	7	4	20	31	109	37	11	157
3-4 PM	67	178	32	276	6	439	32	476	9	6	27	43	149	51	15	215
4-5 PM	78	208	37	323	7	513	37	557	11	7	32	50	174	60	17	251
5-6 PM	48	129	23	201	4	319	23	346	7	4	20	31	108	37	11	156
6-7 PM	35	93	17	145	3	230	17	250	5	3	14	22	78	27	8	113
7-8 PM	25	66	12	103	2	163	12	177	4	2	10	16	55	19	5	80

Time	NB/SB	EB	WB	>EB/WB
6:00	**795**	134	58	**134**
7:00	**743**	125	54	**125**
8:00	496	84	36	84
9:00	381	64	28	64
10:00	499	84	36	84
11:00	535	90	39	90
12:00	397	23	113	113
1:00	386	22	110	110
2:00	549	31	157	157
3:00	**752**	43	215	**215**
4:00	**880**	50	251	**251**
5:00	547	31	156	156
6:00	395	22	113	113
7:00	280	16	80	80

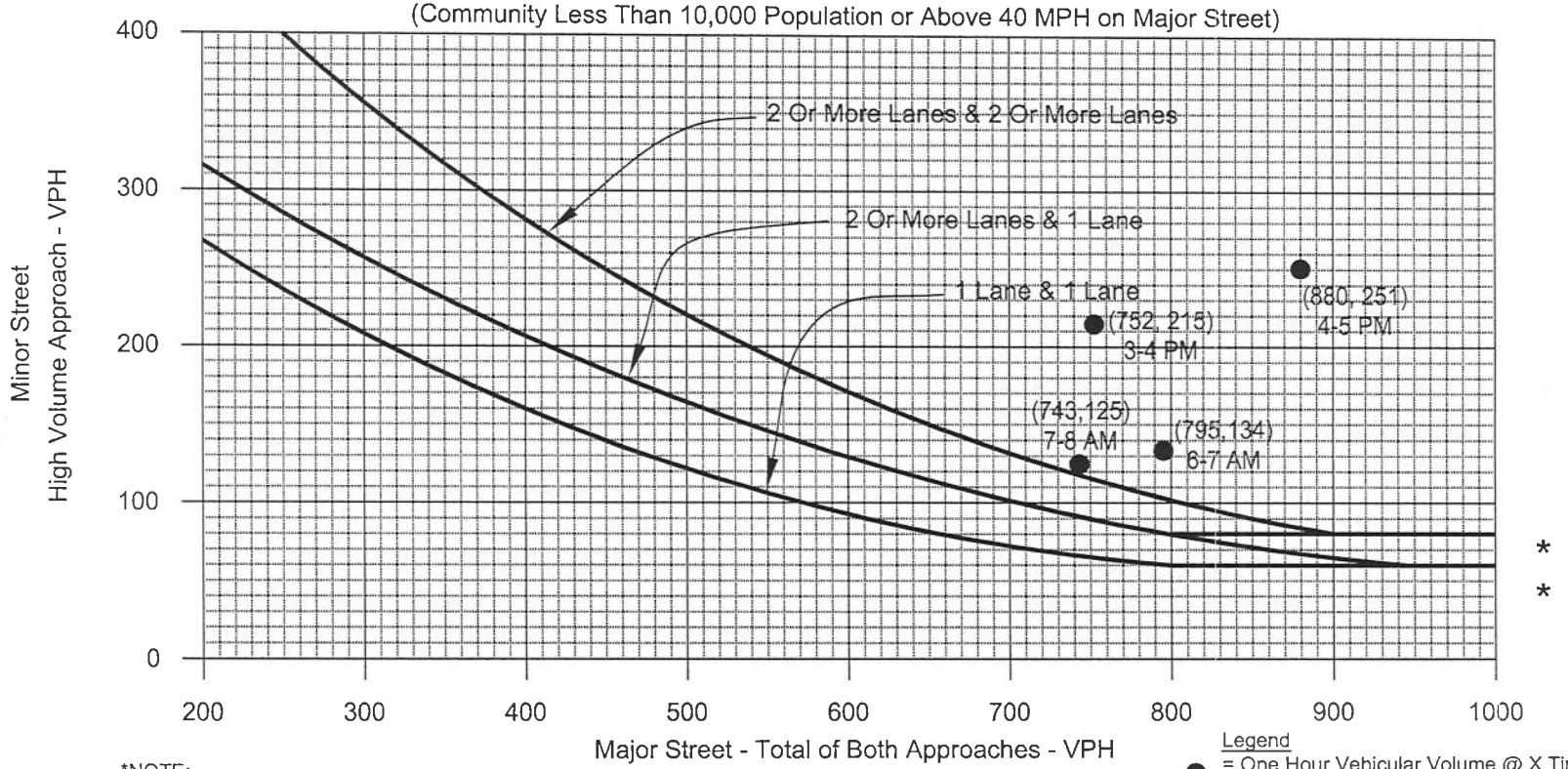
Cosgray Road / Rings Road
2013 Background Traffic
Ohio Manual of Uniform Traffic Control Devices

CONDITION	# OF LANES	Cosgray Road			Rings Road			Condition A				Condition B			
		NB	SB	2-WAY	EB	WB	1-WAY	MAJ	MIN	MAJ	MIN	MAJ	MIN	MAJ	MIN
										80%	80%			80%	80%
Standard	1							500	150	400	120	750	75	600	60
Standard	2+							600	200	480	160	900	100	720	80
High Speed	1			X			X	**350**	**105**	**280**	**84**	**525**	**53**	**420**	**42**
High Speed	2+							420	140	336	112	630	70	504	56
6-7 AM		641	154	**795**	134	58	**134**	YES	YES	YES	YES	YES	YES	YES	YES
7-8 AM		599	144	**743**	125	54	**125**	YES	YES	YES	YES	YES	YES	YES	YES
8-9 AM		400	97	**497**	84	36	**84**	YES	NO	YES	YES	NO	YES	YES	YES
9-10 AM		307	74	**381**	64	27	**64**	YES	NO	YES	NO	NO	YES	NO	YES
10-11 AM		402	97	**499**	85	36	**85**	YES	NO	YES	YES	NO	YES	YES	YES
11-12 NOON		431	104	**535**	90	39	**90**	YES	NO	YES	YES	YES	YES	YES	YES
12-1 PM		146	251	**397**	22	113	**113**	YES	YES	YES	YES	NO	YES	NO	YES
1-2 PM		141	244	**385**	22	109	**109**	YES	YES	YES	YES	NO	YES	NO	YES
2-3 PM		202	347	**549**	31	157	**157**	YES	YES	YES	YES	YES	YES	YES	YES
3-4 PM		277	477	**754**	42	215	**215**	YES	YES	YES	YES	YES	YES	YES	YES
4-5 PM		323	557	**880**	50	251	**251**	YES	YES	YES	YES	YES	YES	YES	YES
5-6 PM		200	346	**546**	31	156	**156**	YES	YES	YES	YES	YES	YES	YES	YES
6-7 PM		145	250	**395**	22	113	**113**	YES	YES	YES	YES	NO	YES	NO	YES
7-8 PM		103	177	**280**	16	79	**79**								
					Hours Met			**12**	**8**	**12**	**11**	**6**	**12**	**8**	**12**
					Hours Warrant Met			**8**		**11**		**6**		**8**	
					Warrant Satisfied ?			**YES**		**YES**		**NO**		**YES**	

Condition A : MET
Condition B : NOT MET
80% of Condition A and B : NOT APPLICABLE

FOUR HOUR VOLUME WARRANT (70% Factor)

(Community Less Than 10,000 Population or Above 40 MPH on Major Street)



*NOTE:
80 VPH applies as the lower threshold volume for a minor street approach with two or more lanes.
60 VPH applies as the lower threshold volume for a minor street approach with one lanes.

Legend
● = One Hour Vehicular Volume @ X Time WARRANTED
○ = One Hour Vehicular Volume @ X Time NOT WARRANTED

Warranted: Yes

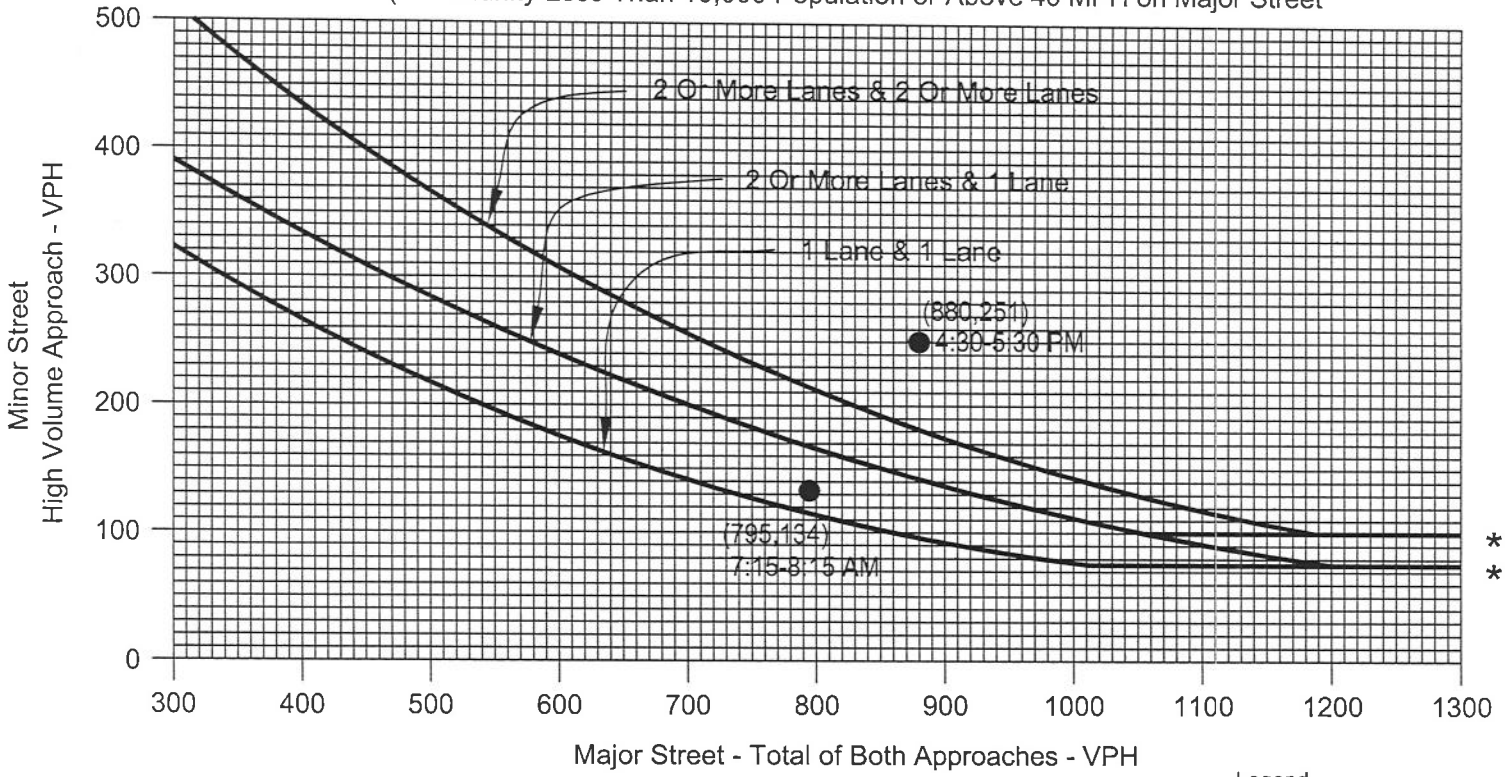
2013 COUNT VOLUMES: COSGRAY ROAD & RINGS ROAD
Traffic Signal Warrant #2
Ohio Manual of Uniform Traffic Control Devices

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
M C M X X V I

Traffic Impact Study
Columbus, Ohio

PEAK HOUR VOLUME WARRANT (70% Factor)

(Community Less Than 10,000 Population or Above 40 MPH on Major Street



*NOTE:
100 VPH applies as the lower threshold volume for a minor street approach with two or more lanes.
75 VPH applies as the lower threshold volume for a minor street approach with one lanes.

Legend
● = One Hour Vehicular Volume @ X Time WARRANTED
○ = One Hour Vehicular Volume @ X Time NOT WARRANTED

Warranted: Yes

2013 COUNT VOLUMES: COSGRAY ROAD & RINGS ROAD
Traffic Signal Warrant #3
Ohio Manual of Uniform Traffic Control Devices

From Avondale TIS

2014 Background Traffic																
	Avery								Cara / Rings							
Hour	NBLT	NBTH	NBRT	**NB Total**	SBLT	SBTH	SBRT	**SB Total**	EBLT	EBTH	EBRT	**EB Total**	WBLT	WBTH	WBRT	**WB Total**
6-7 AM	36	544	4	584	0	285	40	325	212	0	83	295	4	1	5	10
7-8 AM	34	508	4	546	0	266	37	303	198	0	78	276	4	1	5	10
8-9 AM	22	339	2	363	0	178	25	203	132	0	52	184	2	1	3	6
9-10 AM	17	260	2	279	0	136	19	155	101	0	40	141	2	0	2	4
10-11 AM	23	342	3	368	0	179	25	204	133	0	52	185	3	1	3	7
11-12 NOON	24	366	3	393	0	192	27	219	143	0	56	199	3	1	3	7
12-1 PM	32	201	13	246	9	374	75	458	19	3	32	54	5	1	3	9
1-2 PM	31	195	13	239	9	364	73	446	18	3	31	52	5	1	3	9
2-3 PM	44	278	18	340	13	517	104	634	26	4	44	74	7	1	4	12
3-4 PM	60	380	25	465	18	709	143	870	36	6	61	103	9	2	6	17
4-5 PM	70	445	29	544	21	829	167	1017	42	7	71	120	11	2	7	20
5-6 PM	44	277	18	339	13	515	104	632	26	4	44	74	7	1	4	12
6-7 PM	31	199	13	243	9	372	75	456	19	3	32	54	5	1	3	9
7-8 PM	22	142	9	173	7	264	53	324	13	2	23	38	4	1	2	7

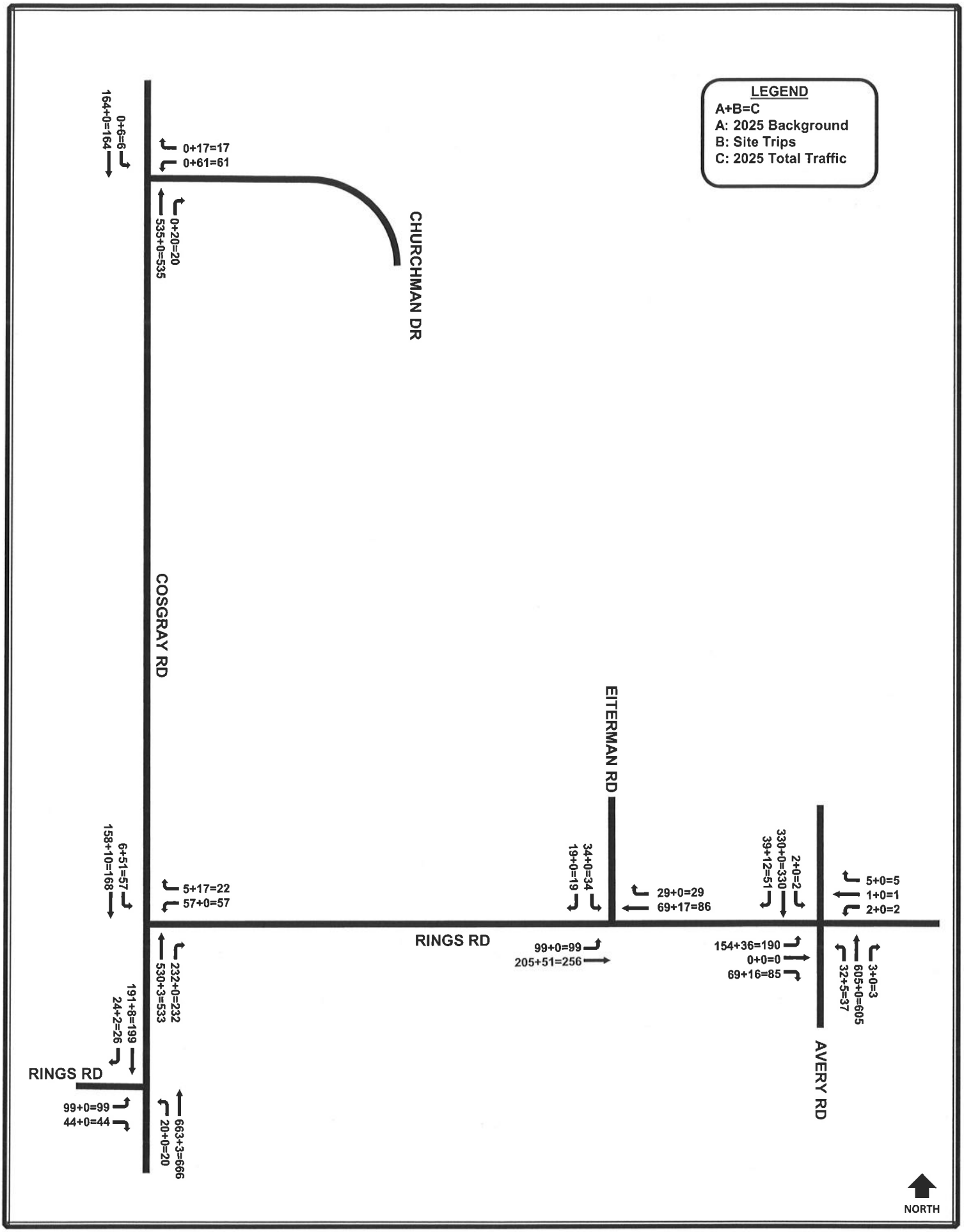
Avery Road / Rings Road / Cara Road
2014 Background Traffic
Ohio Manual of Uniform Traffic Control Devices

CONDITION	# OF LANES	Avery Road NB	Avery Road SB	Avery Road 2-WAY	Rings / Cara EB	Rings / Cara WB	Rings / Cara 1-WAY	Condition A MAJ	Condition A MIN	Condition A MAJ	Condition A MIN	Condition B MAJ	Condition B MIN	Condition B MAJ	Condition B MIN
										80%	80%			80%	80%
Standard	1							500	150	400	120	750	75	600	60
Standard	2+							600	200	480	160	900	100	720	80
High Speed	1			**X**			**X**	**350**	**105**	**280**	**84**	**525**	**53**	**420**	**42**
High Speed	2+							420	140	336	112	630	70	504	56
6-7 AM		584	325	**909**	295	10	**295**	YES	YES	YES	YES	YES	YES	YES	YES
7-8 AM		546	303	**849**	276	10	**276**	YES	YES	YES	YES	YES	YES	YES	YES
8-9 AM		363	203	**566**	184	6	**184**	YES	YES	YES	YES	YES	YES	YES	YES
9-10 AM		279	155	**434**	141	4	**141**	YES	YES	YES	YES	NO	YES	YES	YES
10-11 AM		368	204	**572**	185	7	**185**	YES	YES	YES	YES	YES	YES	YES	YES
11-12 NOON		393	219	**612**	199	7	**199**	YES	YES	YES	YES	YES	YES	YES	YES
12-1 PM		246	458	**704**	54	9	**54**	YES	NO	YES	NO	YES	YES	YES	YES
1-2 PM		239	446	**685**	52	9	**52**	YES	NO	YES	NO	YES	NO	YES	YES
2-3 PM		340	634	**974**	74	12	**74**	YES	NO	YES	NO	YES	YES	YES	YES
3-4 PM		465	870	**1335**	103	17	**103**	YES	NO	YES	YES	YES	YES	YES	YES
4-5 PM		544	1017	**1561**	120	20	**120**	YES	YES	YES	YES	YES	YES	YES	YES
5-6 PM		339	632	**971**	74	12	**74**	YES	NO	YES	NO	YES	YES	YES	YES
6-7 PM		243	456	**699**	54	9	**54**	YES	NO	YES	NO	YES	YES	YES	YES
7-8 PM		173	324	**497**	38	7	**38**								
					Hours Met			12	6	12	7	11	11	12	12
					Hours Warrant Met			6		7		10		12	
					Warrant Satisfied ?			NO		NO		YES		YES	

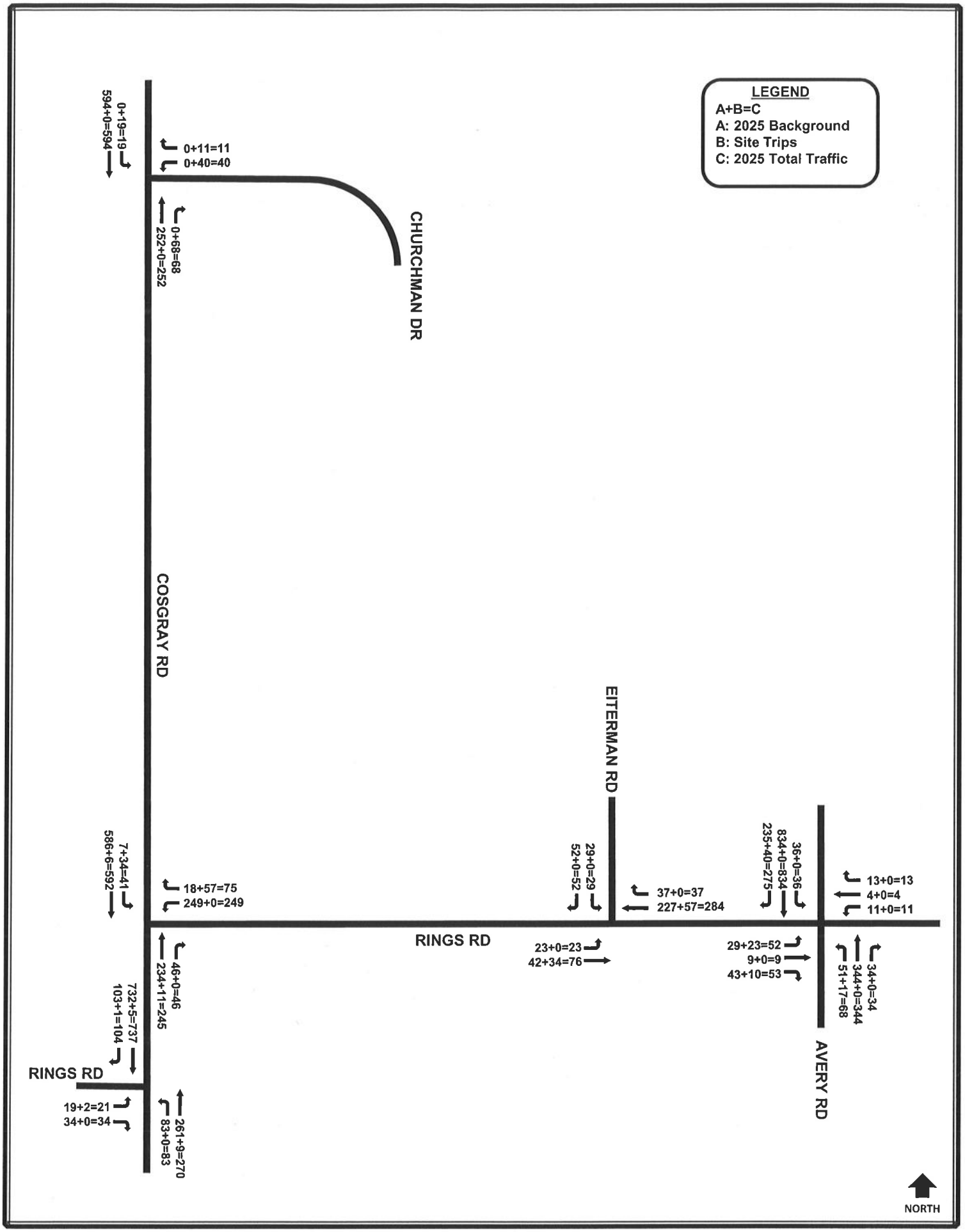
Condition A : NOT MET
Condition B : MET
80% of Condition A and B : NOT APPLICABLE

APPENDIX C
TRAFFIC VOLUME CALCULATIONS

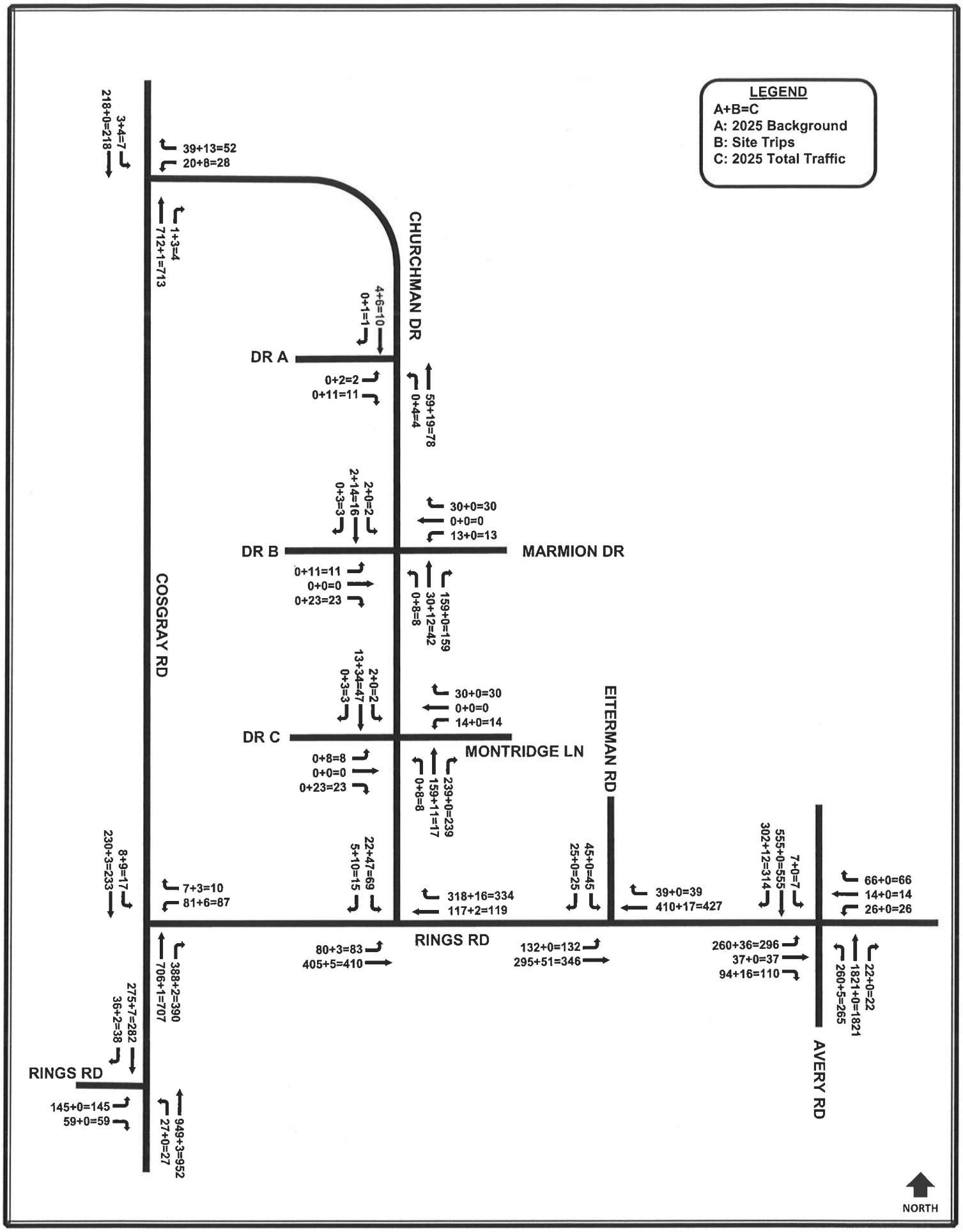
2015 AM Traffic Volumes



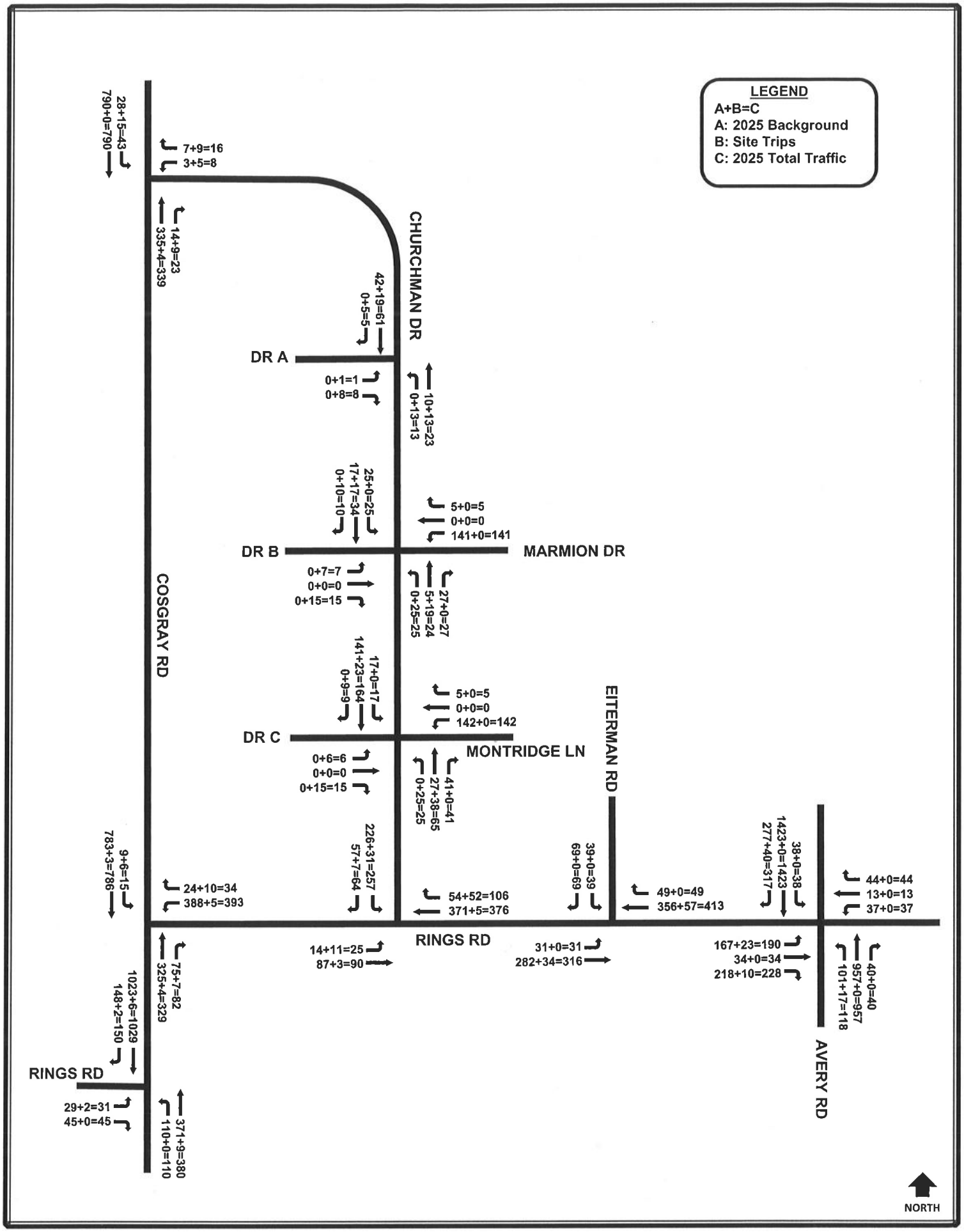
2015 PM Traffic Volumes



2025 AM Traffic Volumes



2025 PM Traffic Volumes



Liggett Tract
Traffic Impact Study
Trip Generation Calculations
Institute of Transportation Engineers, 9th Edition

Land Use	Square Feet or Units	ITE Code	Time Period	ITE Formula	Total Trips	Trips Entering	Trips Exiting
Single Family - Detached	135 units	210	ADT	Ln(T)=0.92Ln(x)+2.72	1,384	692	692
			AM Peak	T=0.70(x)+9.74	104	26	78
			PM Peak	Ln(T)=0.90Ln(x)+0.51	138	87	51

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2013 Count Volumes — AM Peak Hour A

NORTH

	TH	LT		RT														
	154			LT	Churchman Dr													
			502															
			TH	RT		SITE												
			5	RT												5	RT	
RT	TH	LT	13	TH					RT	LT	27	RT	RT	TH	LT	1	TH	
9	139	6	40	LT					18	32	65	TH	37	310	2	2	LT	
	LT	30	19	467	155				LT	93				LT	144	30	568	3
	TH	63	LT	TH	RT				TH	192				TH	0	LT	TH	RT
	RT	41												RT	65			
		Cosgray Rd								Elterman Rd					Avery Rd			

Site trip distribution — AM Peak Hour B

	TH	LT	22%	RT														
		22%	78%	LT	Churchman Dr													
				78%		SITE												
			TH	RT														
			66%	RT													RT	
RT	TH	LT		TH					RT	LT		RT	RT	TH	LT		TH	
2%	10%	66%		LT							66%	TH	46%				LT	
	LT	2%		10%					LT					LT	46%	20%		
	TH		LT	TH	RT				TH	66%				TH		LT	TH	RT
	RT													RT	20%			
		Cosgray Rd								Elterman Rd					Avery Rd			

Site trip assignment — AM Peak Hour C

	TH	LT	17	RT														
		6	61	LT	Churchman Dr													
				20		SITE												
			TH	RT		in	26											
						out	78											
			17	RT													RT	
RT	TH	LT		TH					RT	LT		RT	RT	TH	LT		TH	
2	8	51		LT							17	TH	12				LT	
	LT	0		3					LT					LT	36	5		
	TH		LT	TH	RT				TH	51				TH		LT	TH	RT
	RT													RT	16			
		Cosgray Rd								Elterman Rd					Avery Rd			

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2015 Background Traffic Volumes — **AM Peak Hour** — **D**

Growth rate= 3.3% **Growth factor=** 1.066

NORTH

	TH	LT	0	RT														
	164	0	0	LT	Churchman Dr													
			535		0													
			TH	RT		SITE												
			5	RT												5	RT	
RT	TH	LT	14	TH					RT	LT	29	RT	RT	TH	LT	1	TH	
10	148	6	43	LT					19	34	69	TH	39	330	2	2	LT	
	LT	32	20	498	165				LT	99				LT	154	32	605	3
	TH	67	LT	TH	RT				TH	205				TH	0	LT	TH	RT
	RT	44												RT	69			
		Cosgray Rd								Ellerman Rd					Avery Rd			

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2015 Total Traffic Volumes — **AM Peak Hour D1=C+D**

NORTH

Churchman Dr

SITE

Elterman Rd

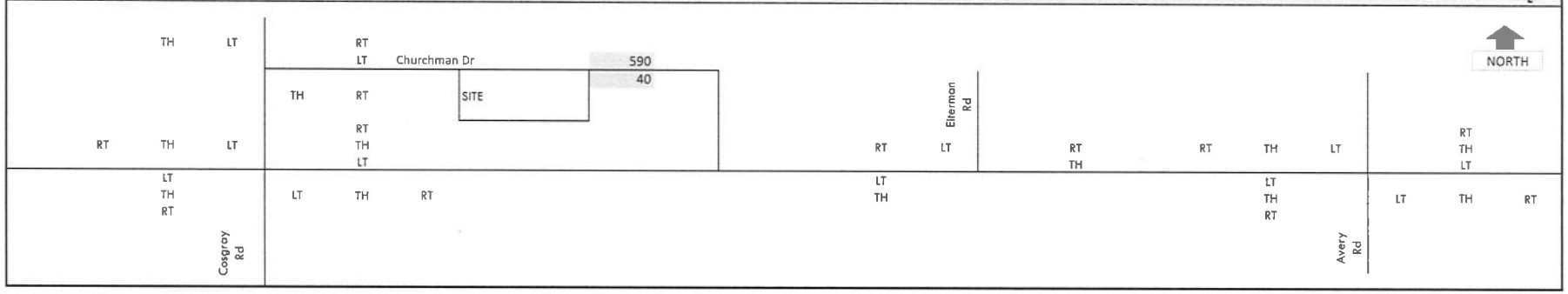
Cosgray Rd

Avery Rd

	TH	LT	17	RT													
	164	6	61	LT													
			535		20												
			TH		RT												
			22		RT										5	RT	
RT	TH	LT	14		TH			RT	LT	29	RT	RT	TH	LT	1	TH	
12	156	57	43		LT			19	34	86	TH	51	330	2	2	LT	
	LT	32	20		501	165		LT	99				LT	190	37	605	3
	TH	67	LT		TH	RT		TH	256				TH	0	LT	TH	RT
	RT	44											RT	85			

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

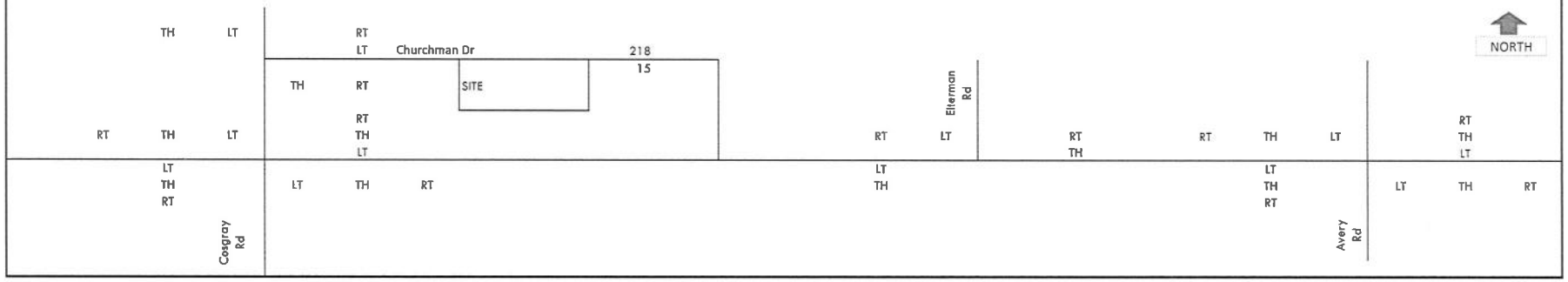
2030 Travel Demand Model Volumes — **AM Peak Hour**



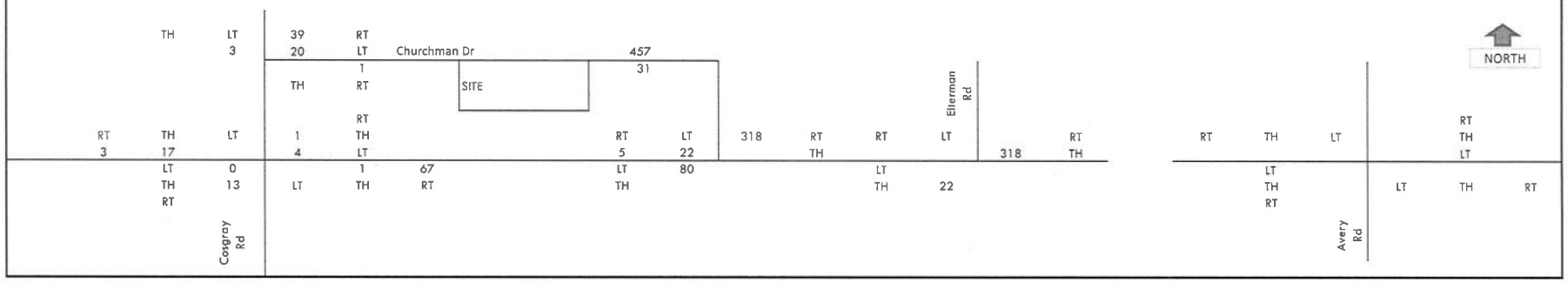
Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2016 Travel Demand Model Volumes
Based on 37% built of planned development on Churchman Drive

AM Peak Hour
E1



2025 **Trips added by connecting both ends of Churchman Dr** **AM Peak Hour F**



2025 Volume calculation at Rings & Avery

AM Peak Hour
G

NORTH

2030 Background from Model
(Plate F of Avondale Woods TIS)

				92	RT	
	RT	TH	LT	20	TH	
Rings	428	601	9	33	LT	
		LT	333	341	2220	28
		TH	52	LT	TH	RT
		RT	111			
			Avery			

2013 Background
(Plate C in Avondale Woods TIS)

				5	RT	
	RT	TH	LT	1	TH	
Rings	40	241	1	2	LT	
		LT	210	25	497	2
		TH	1	LT	TH	RT
		RT	72			
			Avery			

Growth rate

				102.4%	RT	
	RT	TH	LT	111.8%	TH	
Rings	57.1%	8.8%	47.1%	91.2%	LT	
		LT	3.4%	74.4%	20.4%	76.5%
		TH	300.0%	LT	TH	RT
		RT	3.2%			
			Avery Rd			

2025 Volume calculation at Rings & Avery

AM Peak Hour
G1

NORTH

2025 Background
(Trips of Lare Tract and Liggett included)

	RT	TH	LT
Rings	314	495	7
		LT	296
		TH	37
		RT	100
			Avery

Site trips of Avondale Woods and 5300 Avery Road Site
(Plates K & H of Avondale Woods TIS)

				66	RT	
				14	TH	
				24	LT	
				248	1714	20
				LT	TH	RT

				0	RT	
	RT	TH	LT	0	TH	
Rings	0	60	0	2	LT	
		LT	0	17	107	2
		TH	0	LT	TH	RT
		RT	10			
			Avery			

2025 Full Build

				66	RT	
	RT	TH	LT	14	TH	
Rings	314	555	7	26	LT	
		LT	296	265	1821	22
		TH	37	LT	TH	RT
		RT	110			
			Avery Rd			

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

Site trip distribution (w Churchman Dr connected)

AM Peak Hour
H

NORTH

		TH 5%	LT 17%	17% 10% 5% TH 11% 1% 7%	RT LT 10% RT RT TH LT	Churchman Dr	SITE															
RT 1%	TH 3%	LT 11%						RT 13%	LT 60%	60% 6%	RT TH	RT	LT	66%	RT TH	RT 46%	TH	LT		RT TH LT	
	LT TH RT	1% 1%		LT	3% TH	7% RT		LT TH	13% 6%			LT TH	66%				LT TH RT	46% 20%	20% LT	TH	RT	
		Cosgrey Rd																Avery Rd				

Eiterman Rd

Site trip assignment (w Churchman Dr connected) — **AM Peak Hour H1**

NORTH

	TH	LT	13	RT																			
		4	8	LT	Churchman Dr																		
			1	3		SITE																	
			TH	RT		in	26																
						out	78																
			3	RT																			
RT	TH	LT	1	TH				RT	LT	16	RT	LT			RT	RT	TH	LT			RT		
1	2	9	5	LT				10	47	2			17	TH	12						TH		
	LT	0		1	2			LT	3		LT	0				LT	36	5					
	TH	0	LT	TH	RT			TH	5		TH	51				TH		LT	TH	RT			
	RT															RT	16						

Elterman Rd

Cosgrey Rd

Avery Rd

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2025 Background Traffic Volumes w/o Churchman Dr connected) — **AM Peak Hour I**

Growth rate= 3.3% Growth factor= 1.33

NORTH

	TH	LT	0	RT																		
	218	0	0	LT	Churchman Dr																	
			712	0																		
			TH	RT		SITE								Elterman Rd								
			7	RT															0	RT		
RT	TH	LT	19	TH			RT	LT	0	RT	RT	LT	39	RT		RT	TH	LT	0	TH		
13	197	8	57	LT			0	0	117	TH	25	45	92	TH		0	0	0	0	LT		
	LT	43	27	662	219		LT	0			LT	132					LT	0	0	0	0	
	TH	89	LT	TH	RT		TH	405			TH	273					TH	0	LT	TH	RT	
	RT	59															RT	0				
		Cosgray Rd																Avery Rd				

2025 Background Traffic Volumes w/ Churchman Dr connected) — **AM Peak Hour J=I+F (except Avery Rd inter)**

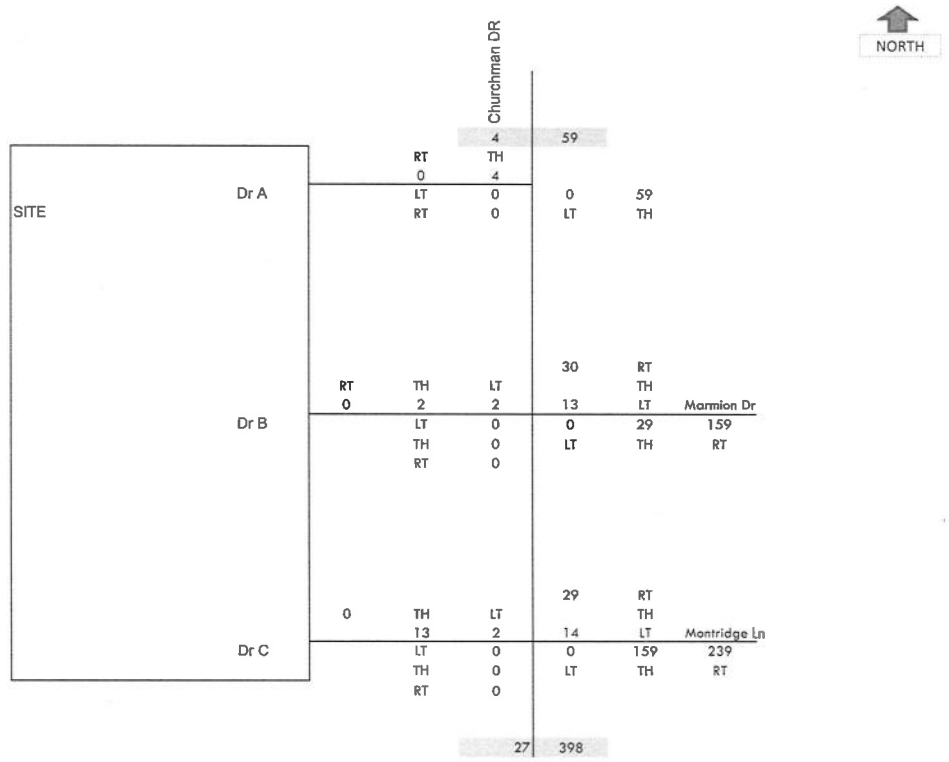
	TH	LT	39	RT																		
	218	3	20	LT	Churchman Dr																	
			712	1																		
			TH	RT		SITE								Elterman Rd								
			7	RT															66	RT		
RT	TH	LT	20	TH			RT	LT	318	RT	RT	LT	39	RT		RT	TH	LT	14	TH		
16	214	8	61	LT			5	22	117	TH	25	45	410	TH		302	555	7	26	LT		
	LT	43	27	663	286		LT	80			LT	132					LT	260	260	1821	22	
	TH	102	LT	TH	RT		TH	405			TH	295					TH	37	LT	TH	RT	
	RT	59															RT	94				
		Cosgray Rd																Avery Rd				

2025 Full Build Traffic Volumes w/ Churchman Dr connected) — **AM Peak Hour K=J+H1**

	TH	LT	52	RT																		
	218	7	28	LT	Churchman Dr																	
			713	4																		
			TH	RT		SITE								Elterman Rd								
			10	RT															66	RT		
RT	TH	LT	21	TH			RT	LT	334	RT	RT	LT	39	RT		RT	TH	LT	14	TH		
17	216	17	66	LT			15	69	119	TH	25	45	427	TH		314	555	7	26	LT		
	LT	43	27	664	288		LT	83			LT	132					LT	296	265	1821	22	
	TH	102	LT	TH	RT		TH	410			TH	346					TH	37	LT	TH	RT	
	RT	59															RT	110				
		Cosgray Rd																Avery Rd				

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2025 **Background Trips added by connecting both ends of Churchman Dr** **AM Peak Hour**
L



Site trip assignment (w Churchman Dr connected) — **AM Peak Hour** **M**

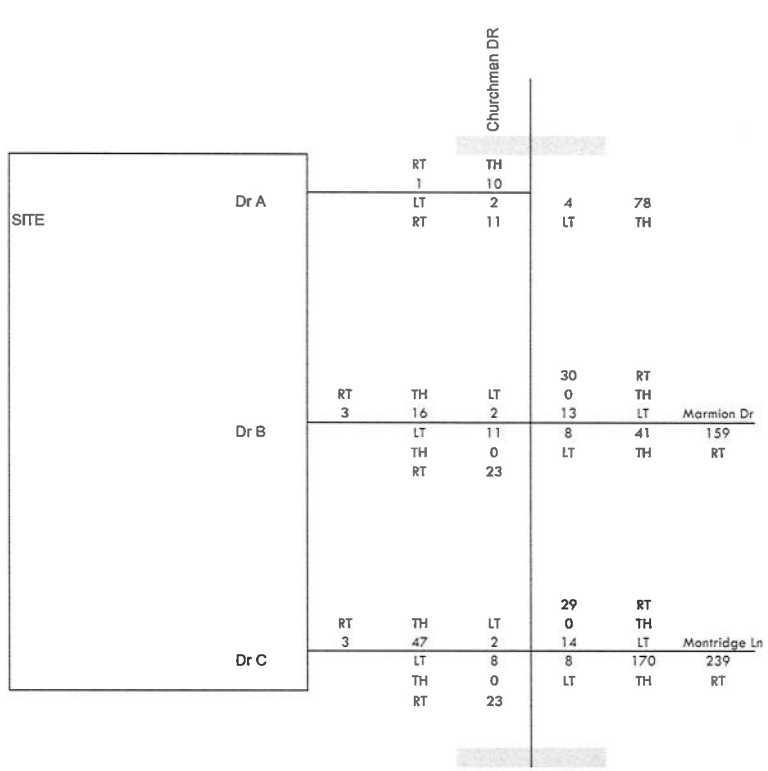
NORTH

SITE
in 26
out 78

Churchman DR

				7	21		
			RT	TH			
			1	6			
		Dr A	LT	2	4	19	
			RT	11	LT	TH	
					0	RT	
	RT		TH	LT	0	TH	
	3		14	0	0	LT	Marmion Dr
		Dr B	LT	11	8	12	
			TH	0	LT	TH	RT
			RT	23			
					0	RT	
	RT		TH	LT	0	TH	
	3		34		0	LT	Montridge Ln
		Dr C	LT	8	8	11	
			TH	0	LT	TH	RT
			RT	23			
				57	19		

2025 Full Build Traffic Volumes w/ Churchman Dr connected) — **AM Peak Hour N=L+M**



Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2013 Count Volumes — **PM Peak Hour A**

NORTH

	TH	LT		RT													
	557			LT	Churchman Dr												
			236														
			TH	RT		SITE											
			17	RT											12	RT	
RT	TH	LT	60	TH				RT	LT	35	RT	RT	TH	LT	4	TH	
37	513	7	174	LT				49	27	213	TH	220	782	34	10	LT	
	LT	11	78	208	37			LT	22				LT	27	48	323	32
	TH	7	LT	TH	RT			TH	39				TH	8	LT	TH	RT
	RT	32											RT	40			

Cosgray Rd — Elterman Rd — Avery Rd

Site trip distribution — **PM Peak Hour B**

NORTH

	TH	LT	22%	RT													
		22%	78%	LT	Churchman Dr												
				78%													
			TH	RT		SITE											
			66%	RT												RT	
RT	TH	LT		TH				RT	LT		RT	RT	TH	LT		TH	
2%	10%	66%		LT						66%	TH	46%				LT	
	LT	2%		10%				LT					LT	46%	20%		
	TH		LT	TH	RT			TH	66%				TH		LT	TH	RT
	RT												RT	20%			

Cosgray Rd — Elterman Rd — Avery Rd

Site trip assignment — **PM Peak Hour C**

NORTH

	TH	LT	11	RT													
		19	40	LT	Churchman Dr												
				68		SITE											
			TH	RT		in	87										
						out	51										
			57	RT												RT	
RT	TH	LT		TH				RT	LT		RT	RT	TH	LT		TH	
1	5	34		LT						57	TH	40				LT	
	LT	2		9				LT					LT	23	17		
	TH		LT	TH	RT			TH	34				TH		LT	TH	RT
	RT												RT	10			

Cosgray Rd — Elterman Rd — Avery Rd

2015 Background Traffic Volumes

Growth rate= 3.3% **Growth factor=** 1.066

PM Peak Hour
D

NORTH

Churchman Dr

SITE

Elterman Rd

Cosgray Rd

Avery Rd

	TH	LT	0	RT													
	594	0	0	LT													
			252		0												
			TH	RT													
			18	RT											13	RT	
RT	TH	LT	64	TH				RT	LT	37	RT	RT	TH	LT	4	TH	
39	547	7	185	LT				52	29	227	TH	235	834	36	11	LT	
	LT	12	83	222	39			LT	23				LT	29	51	344	34
	TH	7	LT	TH	RT			TH	42				TH	9	LT	TH	RT
	RT	34											RT	43			

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2015 Total Traffic Volumes — **PM Peak Hour D1=C+D**

NORTH

Churchman Dr

SITE

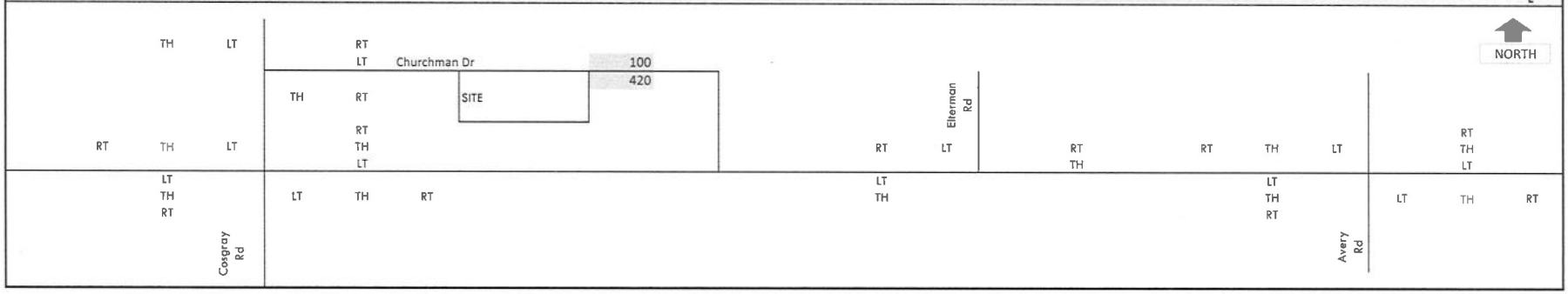
Elterman Rd

Cosgray Rd

Avery Rd

	TH	LT	11	RT													
	594	19	40	LT													
			252	68													
			TH	RT													
			75	RT											13	RT	
RT	TH	LT	64	TH		RT	LT	37	RT	RT	TH	LT	4	TH	
40	552	41	185	LT		52	29	284	TH	275	834	36	11	LT	
	LT	14	83	231	39	LT	23				LT	52	68	344	34
	TH	7	LT	TH	RT	TH	76				TH	9	LT	TH	RT
	RT	34									RT	53			

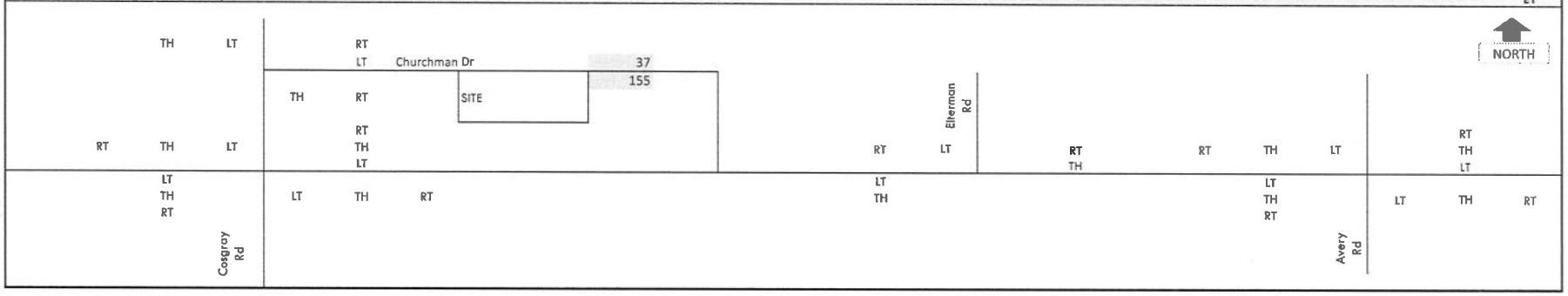
2030 Travel Demand Model Volumes — **PM Peak Hour**



Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2016 Travel Demand Model Volumes
Based on 37% built of planned development on Churchman Drive

PM Peak Hour
E1



2025 **Trips added by connecting both ends of Churchman Dr** **PM Peak Hour F**

NORTH

		TH	LT	7	RT																	
			28	3	LT	Churchman Dr			78													
					14				325													
				TH	RT		SITE															
					RT																	
	RT	TH	LT	10	TH				RT	LT	54	RT	RT	LT		RT	RT	TH	LT		RT	
	1	2		47	LT				57	226		TH			54	TH					TH	
		LT	2		12	12			LT	14			LT					LT			LT	
		TH	2	LT	TH	RT			TH				TH	226				TH		LT	TH	RT
		RT																RT				
			Cosgray Rd																Avery Rd			

Ellerman Rd

2025 Volume calculation at Rings & Avery

PM Peak Hour
G

NORTH

2030 Background from Model
(Plate F of Avondale Woods TIS)

	RT	TH	LT
Rings	381	1460	45
		LT	251
		TH	45
		RT	261
			Avery

60	RT	
17	TH	
42	LT	
112	1009	39
LT	TH	RT

2013 Background
(Plate C in Avondale Woods TIS)

	RT	TH	LT
Rings	165	684	21
	Rings	LT	42
	Road	TH	7
		RT	36
			Avery

7	RT	
2	TH	
5	LT	
37	307	23
LT	TH	RT

Growth rate

	RT	TH	LT
Rings	7.7%	6.7%	6.7%
		LT	29.3%
		TH	31.9%
		RT	36.8%
			Avery Rd

44.5%	RT	
44.1%	TH	
43.5%	LT	
11.9%	13.5%	4.1%
LT	TH	RT

2025 Volume calculation at Rings & Avery

PM Peak Hour
G1

NORTH

2025 Background
rips of Lare Tract and Liggett included)

	RT	TH	LT
Rings	317	1234	38
		LT	190
		TH	34
		RT	195
			Avery

Site trips of Avondale Woods and 5300 Avery Road Site
(Plates K & H of Avondale Woods TIS)

				44	RT	
				13	TH	
				31	LT	
				90	804	34
				LT	TH	RT

	RT	TH	LT
Rings	0	189	0
		LT	0
		TH	0
		RT	33
			Avery

				0	RT	
				0	TH	
				6	LT	
				28	153	6
				LT	TH	RT

2025 Full Build

	RT	TH	LT
Rings	317	1423	38
		LT	190
		TH	34
		RT	228
			Avery Rd

				44	RT	
				13	TH	
				37	LT	
				118	957	40
				LT	TH	RT

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

Site trip distribution (w Churchman Dr connected)

PM Peak Hour
H

NORTH

	TH 5%	LT 17%	17% 10% 5% TH 11%	RT LT 10% RT RT	Churchman Dr	SITE														
RT 1%	TH 3%	LT 11%	1% 7%	TH LT			RT 13%	LT 60%	60% 6%	RT TH	RT	LT	66%	RT TH	RT 46%	TH	LT		RT TH LT	
	LT TH RT	1% 1%	LT	3% TH	7% RT		LT TH	13% 6%			LT TH	66%				LT TH RT	46% 20%	20% LT	TH	RT

Cosgray Rd

Eliermen Rd

Avery Rd

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

Site trip assignment (w Churchman Dr connected)

PM Peak Hour
H1

NORTH

	TH	LT	9	RT																			
		15	5	LT	Churchman Dr																		
			4	9		SITE																	
			TH	RT		in	87																
						out	51																
			10	RT																			
RT	TH	LT	1	TH				RT	LT	52	RT	LT									RT		
1	2	6	4	LT				7	31	5			57	RT	RT	TH	LT				TH		
	LT	1		3	6			LT	11		LT	0		TH							LT		
	TH	1	LT	TH	RT			TH	3		TH	34									TH		
	RT																				RT		
		Cosgray Rd										Elterman Rd						Avery Rd					
																			17				
																			LT	TH	RT		

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations

2025 Background Traffic Volumes w/o Churchman Dr connected)
Growth rate= 3.3% Growth factor= 1.33
PM Peak Hour
I

NORTH

	TH	LT	0	RT																		
	790	0	0	LT	Churchman Dr																	
			335	0																		
			TH	RT		SITE																
												Ellerman Rd										
			24	RT															0	RT		
RT	TH	LT	85	TH			RT	LT	0	RT	RT	LT	49	RT	RT	TH	LT		0	TH		
52	728	9	246	LT			0	0	371	TH	69	39	302	TH	0	0	0		0	LT		
	LT	16	110	295	52		LT	0			LT	31				LT	0		0	0	0	
	TH	9	LT	TH	RT		TH	87			TH	56				TH	0		LT	TH	RT	
	RT	45														RT	0					
		Cosgray Rd															Avery Rd					

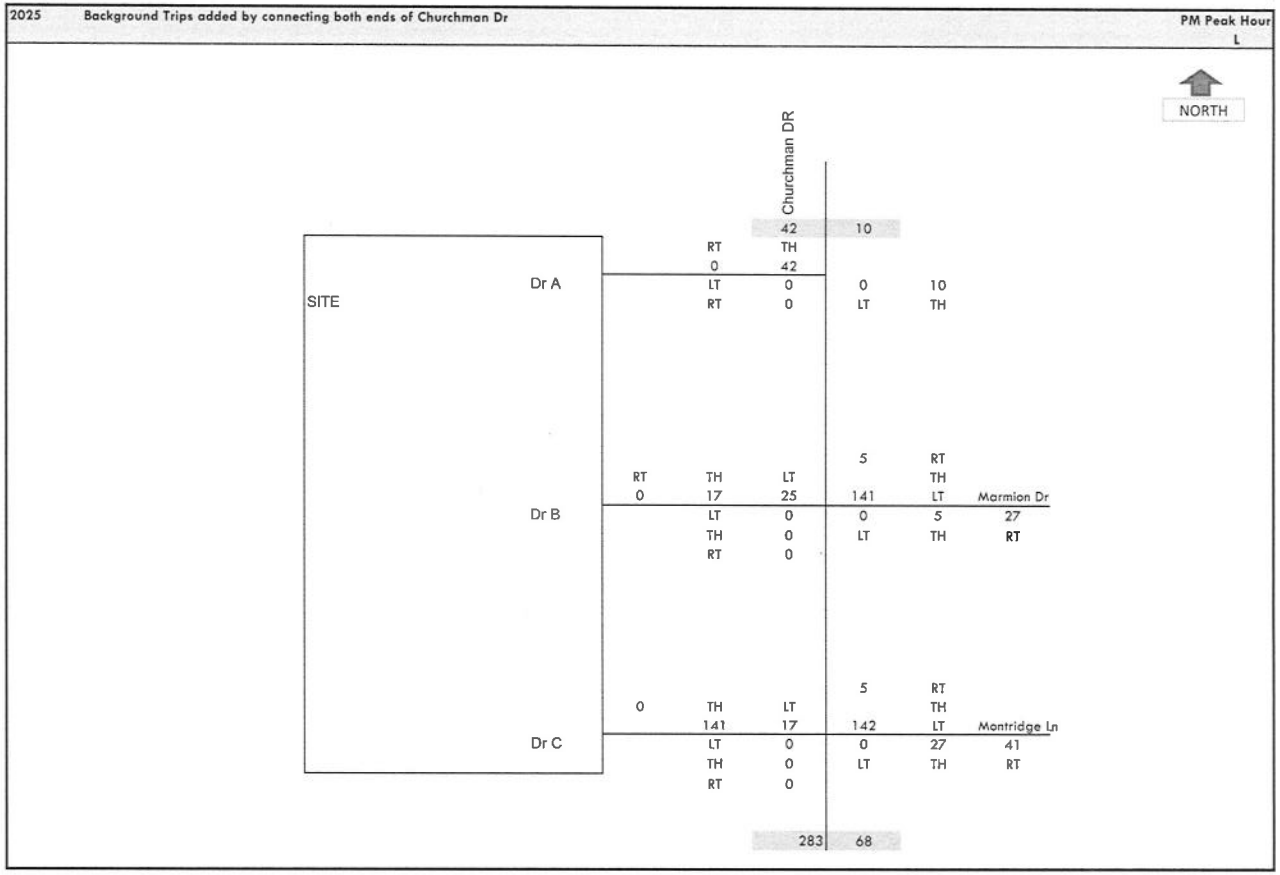
2025 Background Traffic Volumes w/ Churchman Dr connected)
PM Peak Hour
J=I+F (except Avery Rd inter)

	TH	LT	7	RT																		
	790	28	3	LT	Churchman Dr																	
			335	14																		
			TH	RT		SITE																
												Ellerman Rd										
			24	RT															44	RT		
RT	TH	LT	95	TH			RT	LT	54	RT	RT	LT	49	RT	RT	TH	LT		13	TH		
53	730	9	293	LT			57	226	371	TH	69	39	356	TH	277	1423	38		37	LT		
	LT	18	110	307	64		LT	14			LT	31				LT	167		101	957	40	
	TH	11	LT	TH	RT		TH	87			TH	282				TH	34		LT	TH	RT	
	RT	45														RT	218					
		Cosgray Rd															Avery Rd					

2025 Full Build Traffic Volumes w/ Churchman Dr connected)
PM Peak Hour
K=J+H1

	TH	LT	16	RT																		
	790	43	8	LT	Churchman Dr																	
			339	23																		
			TH	RT		SITE																
												Ellerman Rd										
			34	RT															44	RT		
RT	TH	LT	96	TH			RT	LT	106	RT	RT	LT	49	RT	RT	TH	LT		13	TH		
54	732	15	297	LT			64	257	376	TH	69	39	413	TH	317	1423	38		37	LT		
	LT	19	110	310	70		LT	25			LT	31				LT	190		118	957	40	
	TH	12	LT	TH	RT		TH	90			TH	316				TH	34		LT	TH	RT	
	RT	45														RT	228					
		Cosgray Rd															Avery Rd					

Ballantrae Woods
Traffic Impact Study
Traffic Volume Calculations



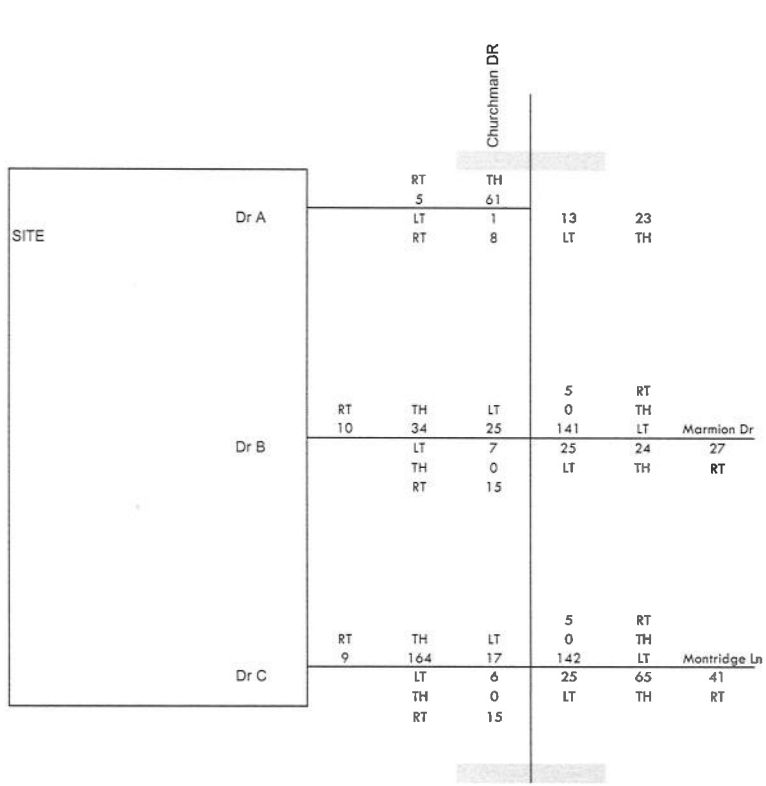
Site trip assignment (w Churchman Dr connected)

PM Peak Hour
M

NORTH

						Churchman DR			
						24	14		
				RT		TH			
				5		19			
		Dr A		LT		1	13	13	
SITE				RT		8	LT	TH	
in	87								
out	51								
							0	RT	
			RT	TH		LT	0	TH	
			10	17		0	0	LT	Marmion Dr
		Dr B		LT		7	25	19	
				TH		0	LT	TH	RT
				RT		15			
							0	RT	
			RT	TH		LT	0	TH	
			9	23			0	LT	Montridge Ln
		Dr C		LT		6	25	38	
				TH		0	LT	TH	RT
				RT		15			
						38	63		

2025 Full Build Traffic Volumes w/ Churchman Dr connected) — **PM Peak Hour N=L+M**

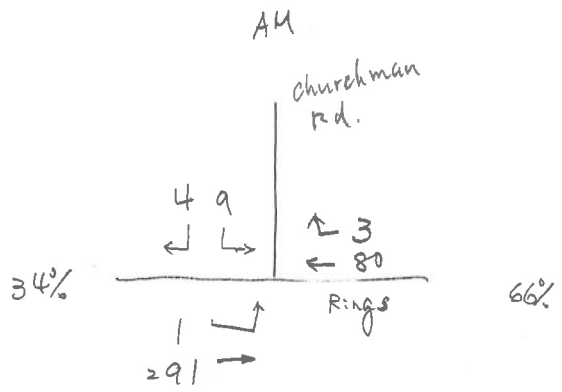


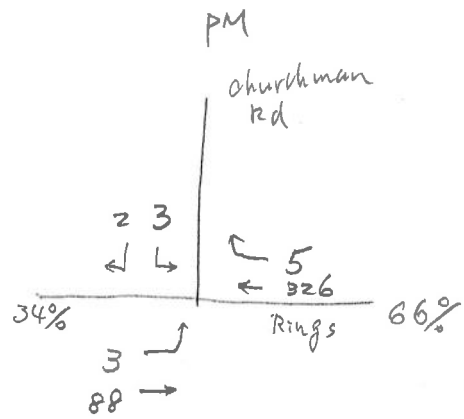
Liggett Tract
Traffic Impact Study
Trip Generation Calculations
Institute of Transportation Engineers, 9th Edition

Links at Ballantrae

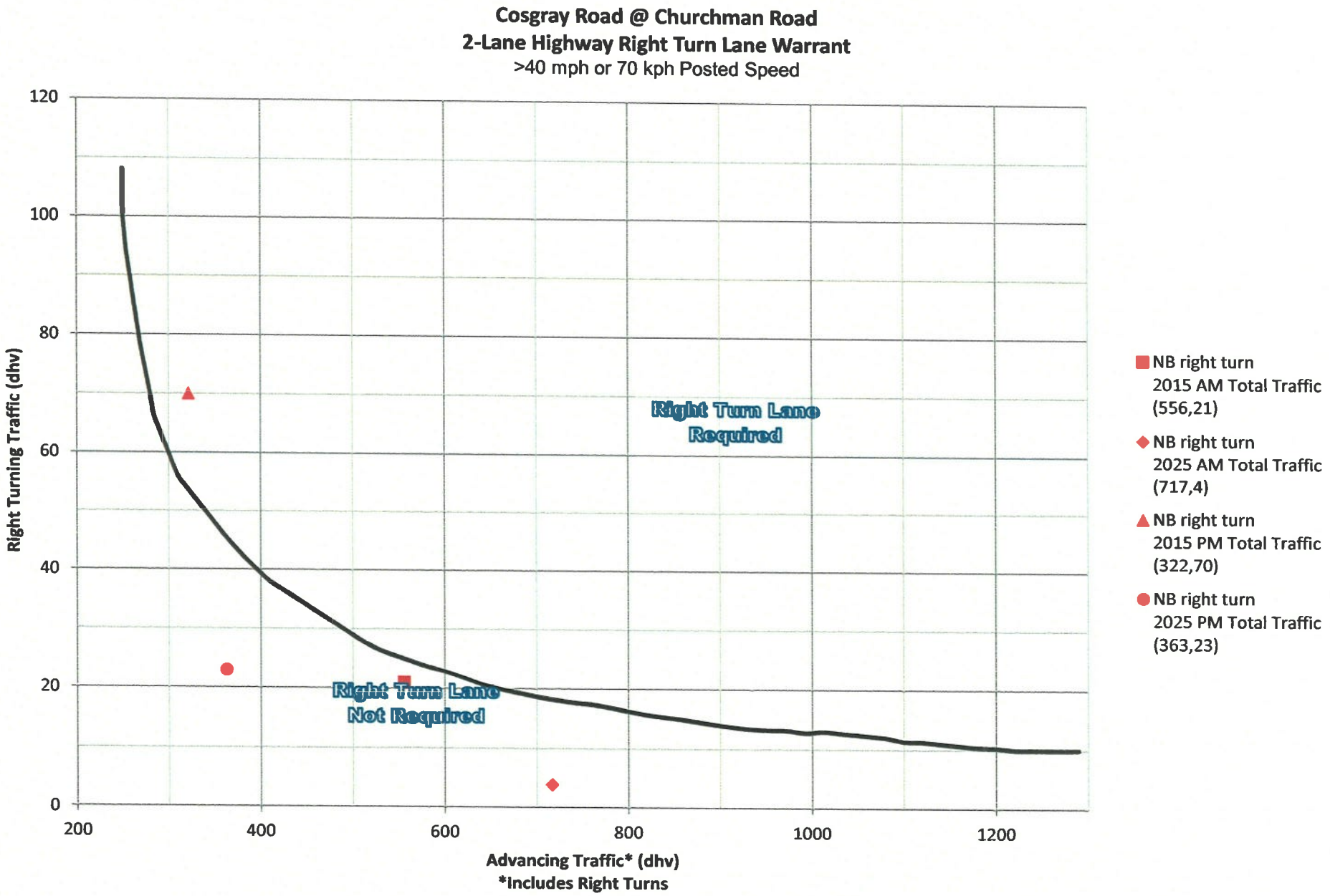
Land Use	Square Feet or Units	ITE Code	Time Period	ITE Formula	Total Trips	Trips Entering	Trips Exiting
Single Family - Detached	10 units	210	ADT	Ln(T)=0.92Ln(x)+2.72	126	63	63
			AM Peak	T=0.70(x)+9.74	17	4	13
			PM Peak	Ln(T)=0.90Ln(x)+0.51	13	8	5

2015



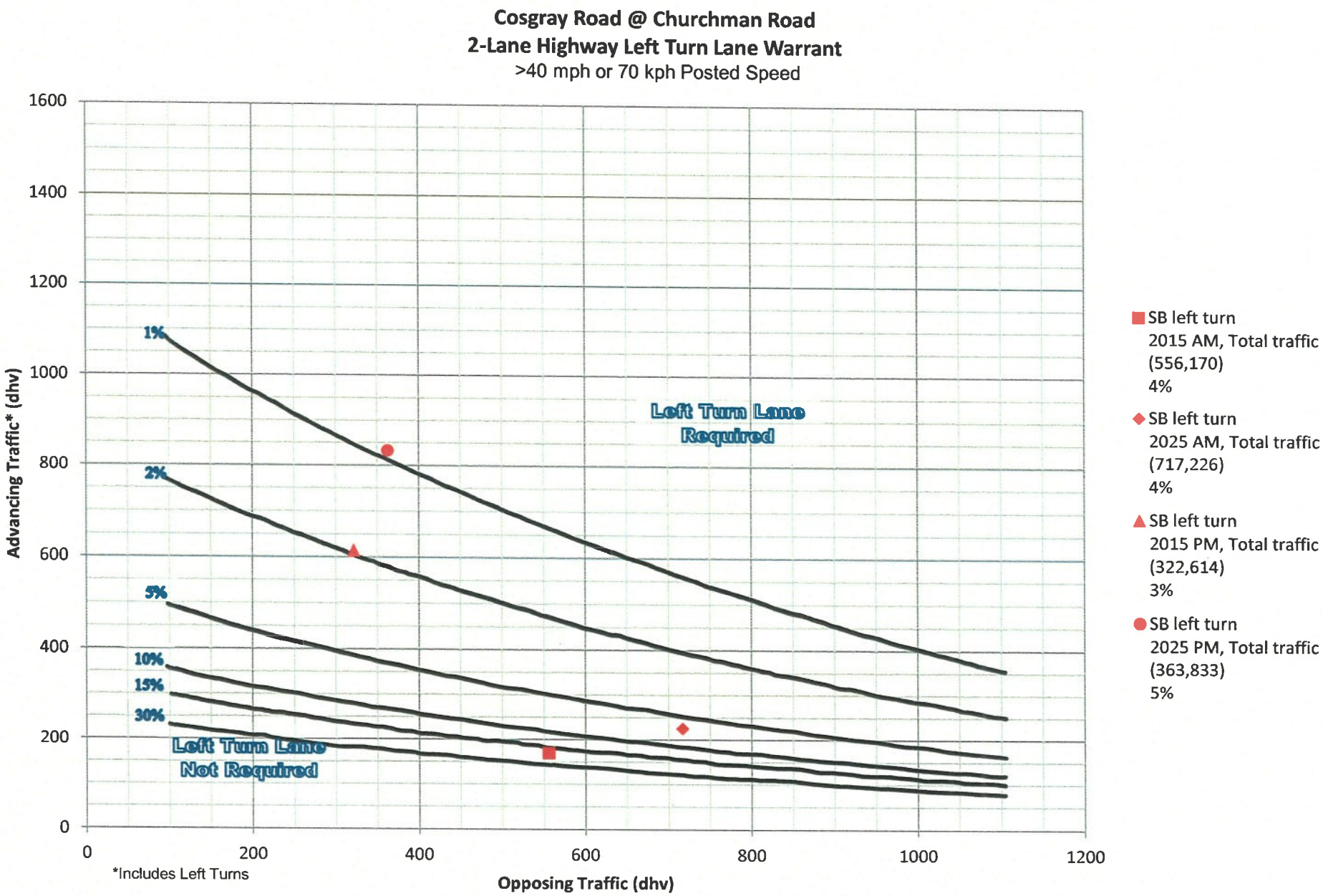


APPENDIX D
TURN LANE WARRANTS



TurnLaneWarrants_Liggett.xls

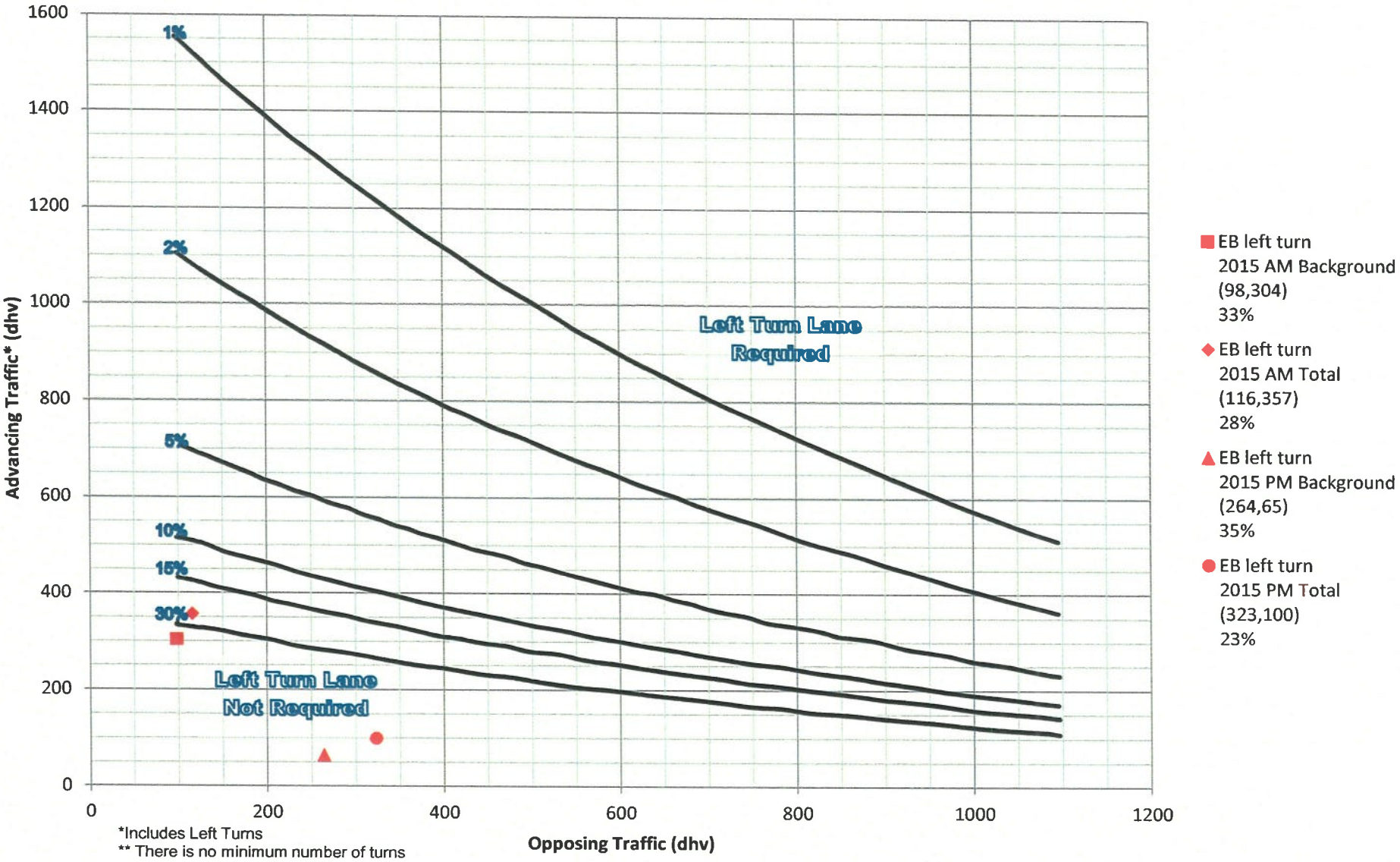
Fig. 401-6bE
ODOT Location and Design Manual, Volume One October 2004



TurnLaneWarrants_Liggett.xls

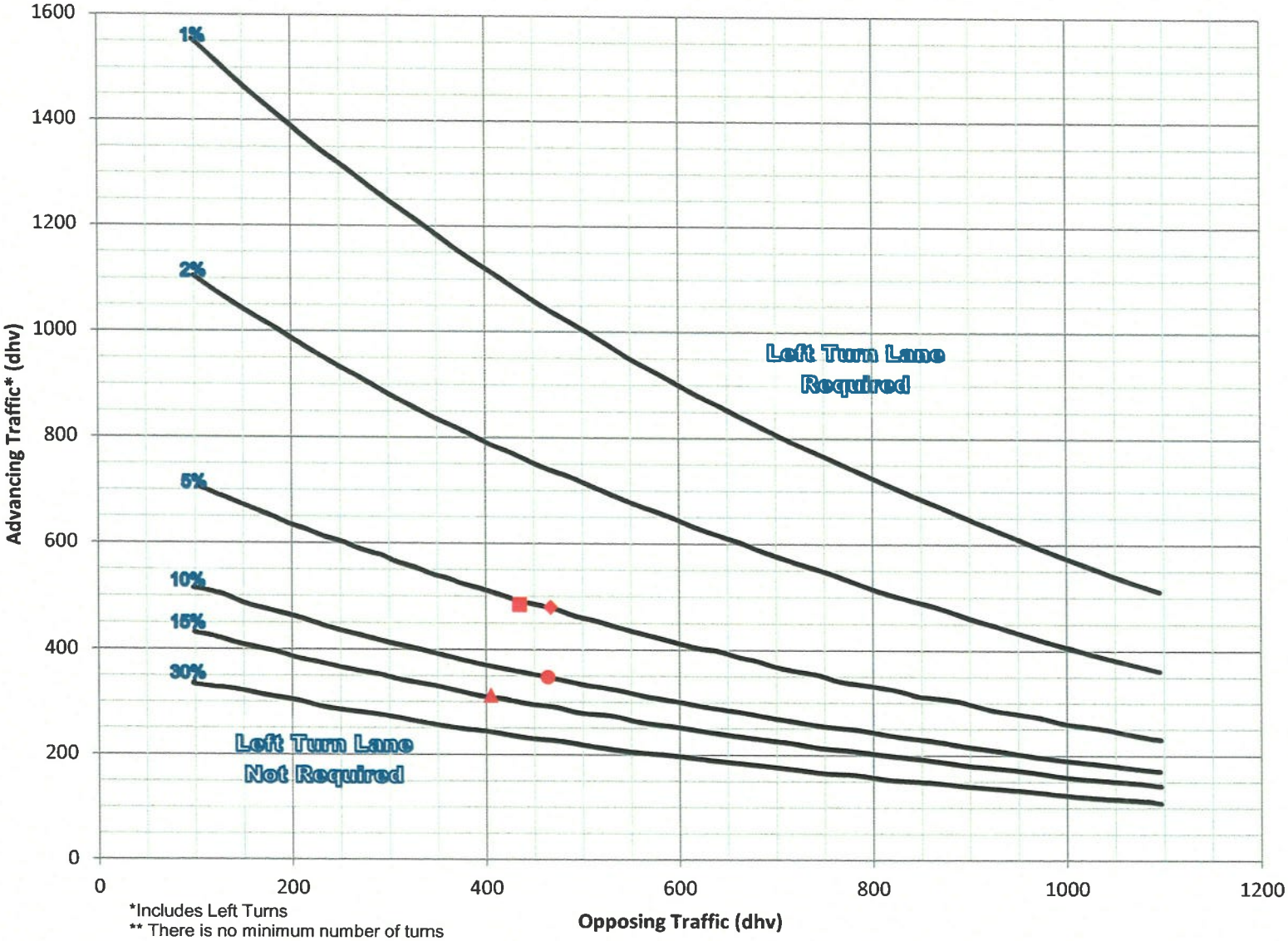
Fig. 401-5bE
ODOT Location and Design Manual, Volume One October 2004

Rings Road @ Eiterman Road
2-Lane Highway Left Turn Lane Warrant
=<40 mph or 70 kph Posted Speed



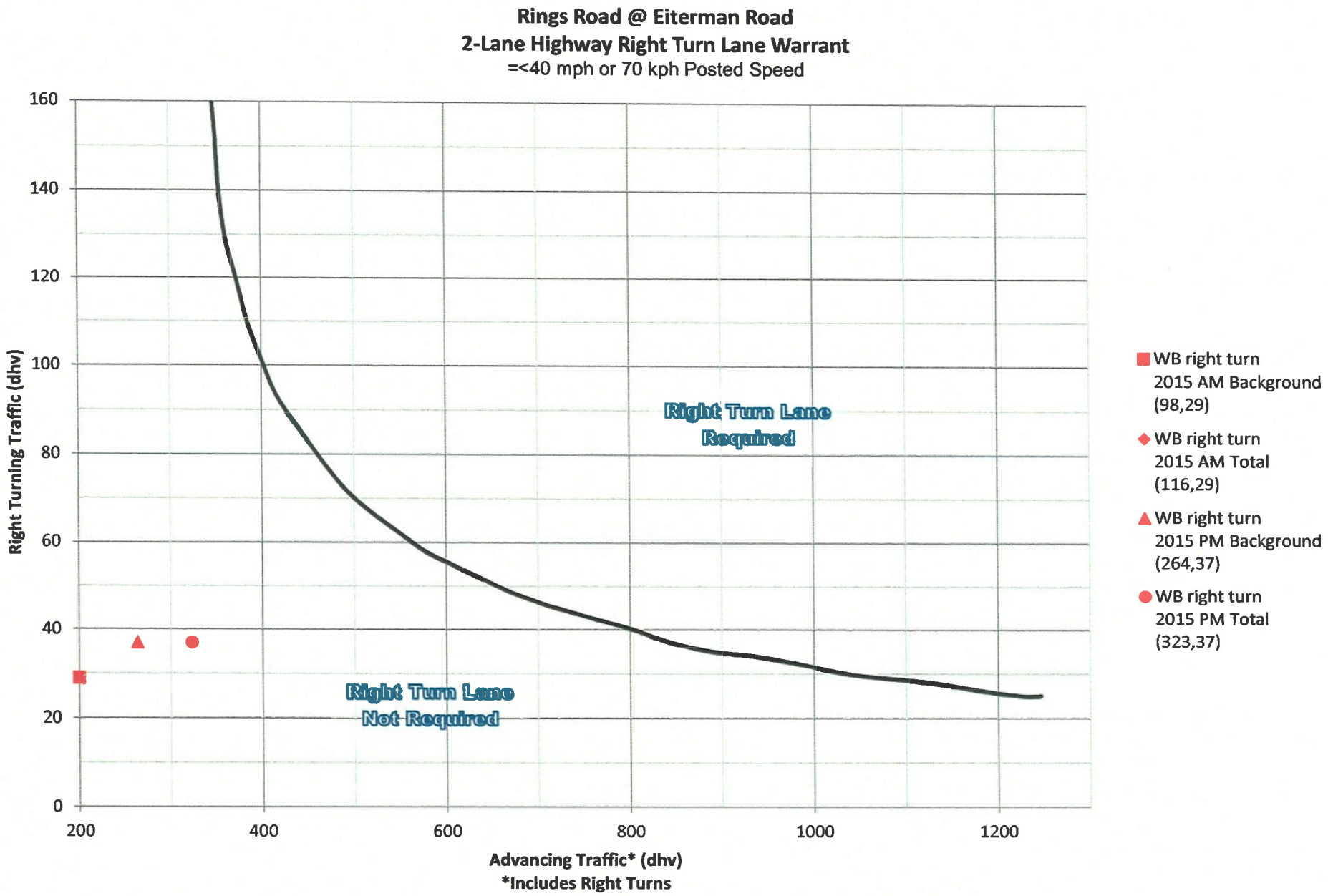
*Includes Left Turns
** There is no minimum number of turns

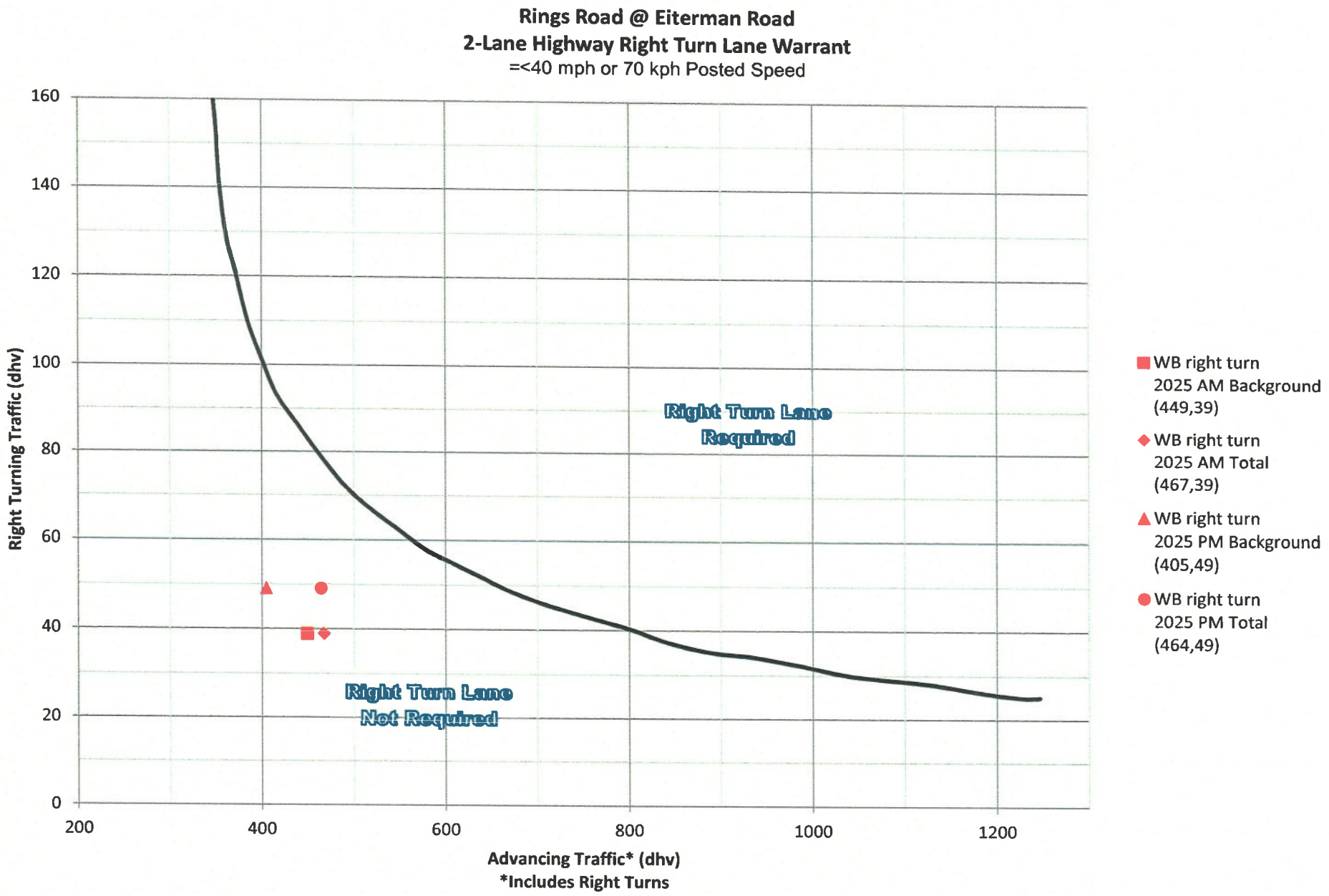
Rings Road @ Eiterman Road
2-Lane Highway Left Turn Lane Warrant
=<40 mph or 70 kph Posted Speed



*Includes Left Turns
** There is no minimum number of turns

- EB left turn 2025 AM Background (435,485) 16%
- EB left turn 2025 AM Total (467,480) 28%
- EB left turn 2025 PM Background (405,313) 10%
- EB left turn 2025 PM Total (464,348) 9%


Rings Road @ Eiterman Road
2-Lane Highway Right Turn Lane Warrant
=<40 mph or 70 kph Posted Speed
Right Turning Traffic (dhv)
160
140
120
100
80
60
40
20
0
200
400
600
800
1000
1200
Advancing Traffic* (dhv)
*Includes Right Turns
Right Turn Lane Required
Right Turn Lane Not Required
WB right turn 2015 AM Background (98,29)
WB right turn 2015 AM Total (116,29)
WB right turn 2015 PM Background (264,37)
WB right turn 2015 PM Total (323,37)



TurnLaneWarrants_Liggett.xls

Fig. 401-6aE
ODOT Location and Design Manual, Volume One October 2004

APPENDIX E
CAPACITY ANALYSIS REPORTS

COSGRAY ROAD/RINGS ROAD

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2015 AM, Background Traffic		

Project Description	Ballantrae Woods, 2014-1763
East/West Street: Rings Road North	North/South Street: Cosgray Road
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		530	232	6	158	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	576	252	6	171	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				57		5
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	61	0	5
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		6		66				
C (m) (veh/h)		808		322				
v/c		0.01		0.20				
95% queue length		0.02		0.76				
Control Delay (s/veh)		9.5		19.0				
LOS		A		C				
Approach Delay (s/veh)	--	--	19.0					
Approach LOS	--	--	C					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:26 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2015 AM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road North* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		533	232	57	168	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	579	252	61	182	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				57		22
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	61	0	23
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		61		84				
C (m) (veh/h)		806		280				
v/c		0.08		0.30				
95% queue length		0.24		1.22				
Control Delay (s/veh)		9.8		23.3				
LOS		A		C				
Approach Delay (s/veh)	--	--	23.3					
Approach LOS	--	--	C					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:20 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2025 AM, Background Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road North* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		706	388	8	230	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	767	421	8	249	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				81		7
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	88	0	7
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		8		95				
C (m) (veh/h)		591		196				
v/c		0.01		0.48				
95% queue length		0.04		2.38				
Control Delay (s/veh)		11.2		39.5				
LOS		B		E				
Approach Delay (s/veh)	--	--	39.5					
Approach LOS	--	--	E					

Copyright © 2007 University of Florida, All Rights Reserved

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2025 AM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road North* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		707	390	17	233	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	768	423	18	253	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				87		10
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	94	0	10
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		18		104				
C (m) (veh/h)		590		188				
v/c		0.03		0.55				
95% queue length		0.09		2.91				
Control Delay (s/veh)		11.3		45.6				
LOS		B		E				
Approach Delay (s/veh)	--	--	45.6					
Approach LOS	--	--	E					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:22 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2015 PM, Background Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road North* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		234	46	7	586	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	254	49	7	636	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				249		18
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	270	0	19
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		7		289				
C (m) (veh/h)		1264		309				
v/c		0.01		0.94				
95% queue length		0.02		9.24				
Control Delay (s/veh)		7.9		73.6				
LOS		A		F				
Approach Delay (s/veh)	--	--	73.6					
Approach LOS	--	--	F					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:20 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2015 PM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road North* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		245	46	41	592	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	266	49	44	643	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				249		75
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	270	0	81
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		44		351				
C (m) (veh/h)		1251		300				
v/c		0.04		1.17				
95% queue length		0.11		15.09				
Control Delay (s/veh)		8.0		143.5				
LOS		A		F				
Approach Delay (s/veh)	--	--	143.5					
Approach LOS	--	--	F					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:21 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2025 PM, Background Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road North* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		325	75	9	783	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	353	81	9	851	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				388		24
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	421	0	26
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		9		447				
C (m) (veh/h)		1131		195				
v/c		0.01		2.29				
95% queue length		0.02		36.14				
Control Delay (s/veh)		8.2		636.1				
LOS		A		F				
Approach Delay (s/veh)	--	--	636.1					
Approach LOS	--	--	F					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:22 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	1/27/2015	Analysis Year	
Analysis Time Period	2025 PM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road North* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		329	82	15	786	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	357	89	16	854	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				393		34
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	427	0	36
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		16		463				
C (m) (veh/h)		1120		190				
v/c		0.01		2.44				
95% queue length		0.04		38.62				
Control Delay (s/veh)		8.3		701.2				
LOS		A		F				
Approach Delay (s/veh)	--	--	701.2					
Approach LOS	--	--	F					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:22 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2015 AM, Background Traffic		

Project Description: Ballantrae Woods, 2014-1763

East/West Street: Rings Road South | North/South Street: Cosgray Road

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	20	663			191	24
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	21	720	0	0	207	26
Percent Heavy Vehicles	3	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	99		44			
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	107	0	47	0	0	0
Percent Heavy Vehicles	3	0	3	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	21						154	
C (m) (veh/h)	1329						340	
v/c	0.02						0.45	
95% queue length	0.05						2.26	
Control Delay (s/veh)	7.8						24.1	
LOS	A						C	
Approach Delay (s/veh)	--	--				24.1		
Approach LOS	--	--				C		

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:37 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2015 AM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road South* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	20	666			199	26
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	21	723	0	0	216	28
Percent Heavy Vehicles	3	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	99		44			
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	107	0	47	0	0	0
Percent Heavy Vehicles	3	0	3	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	21						154	
C (m) (veh/h)	1316						334	
v/c	0.02						0.46	
95% queue length	0.05						2.33	
Control Delay (s/veh)	7.8						24.7	
LOS	A						C	
Approach Delay (s/veh)	--	--				24.7		
Approach LOS	--	--				C		

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:40 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2025 AM, Background Traffic		

Project Description Ballantrae Woods, 2014-1763	
East/West Street: Rings Road South	North/South Street: Cosgray Road
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	27	949			275	36
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	29	1031	0	0	298	39
Percent Heavy Vehicles	3	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	145		59			
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	157	0	64	0	0	0
Percent Heavy Vehicles	3	0	3	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	29						221	
C (m) (veh/h)	1217						192	
v/c	0.02						1.15	
95% queue length	0.07						11.09	
Control Delay (s/veh)	8.0						162.0	
LOS	A						F	
Approach Delay (s/veh)	--	--				162.0		
Approach LOS	--	--				F		

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:47 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2025 AM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road South* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	27	952			282	38
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	29	1034	0	0	306	41
Percent Heavy Vehicles	3	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	145		59			
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	157	0	64	0	0	0
Percent Heavy Vehicles	3	0	3	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	29						221	
C (m) (veh/h)	1206						190	
v/c	0.02						1.16	
95% queue length	0.07						11.24	
Control Delay (s/veh)	8.1						166.8	
LOS	A						F	
Approach Delay (s/veh)	--	--				166.8		
Approach LOS	--	--				F		

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:48 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2015 PM, Background Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road South* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	83	261			732	103
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	90	283	0	0	795	111
Percent Heavy Vehicles	3	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	19		34			
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	20	0	36	0	0	0
Percent Heavy Vehicles	3	0	3	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	90						56	
C (m) (veh/h)	747						242	
v/c	0.12						0.23	
95% queue length	0.41						0.87	
Control Delay (s/veh)	10.5						24.3	
LOS	B						C	
Approach Delay (s/veh)	--	--				24.3		
Approach LOS	--	--				C		

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:43 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2015 PM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road South* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	83	270			737	104
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	90	293	0	0	801	113
Percent Heavy Vehicles	3	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	21		34			
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	22	0	36	0	0	0
Percent Heavy Vehicles	3	0	3	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	90						58	
C (m) (veh/h)	742						233	
v/c	0.12						0.25	
95% queue length	0.41						0.95	
Control Delay (s/veh)	10.5						25.5	
LOS	B						D	
Approach Delay (s/veh)	--	--				25.5		
Approach LOS	--	--				D		

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:45 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2025 PM, Background Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road South* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	110	371			1023	148
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	119	403	0	0	1111	160
Percent Heavy Vehicles	3	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	29		45			
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	31	0	48	0	0	0
Percent Heavy Vehicles	3	0	3	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	119						79	
C (m) (veh/h)	543						115	
v/c	0.22						0.69	
95% queue length	0.83						3.64	
Control Delay (s/veh)	13.5						86.9	
LOS	B						F	
Approach Delay (s/veh)	--	--	86.9					
Approach LOS	--	--	F					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:50 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed		Analysis Year	
Analysis Time Period	2025 PM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Rings Road South* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	110	380			1029	150
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	119	413	0	0	1118	163
Percent Heavy Vehicles	3	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	31		45			
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	33	0	48	0	0	0
Percent Heavy Vehicles	3	0	3	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	119						81	
C (m) (veh/h)	538						110	
v/c	0.22						0.74	
95% queue length	0.84						3.99	
Control Delay (s/veh)	13.6						98.3	
LOS	B						F	
Approach Delay (s/veh)	--	--				98.3		
Approach LOS	--	--				F		

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 10:51 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	32	67	44	43	14	5	20	498	165	6	148	10
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	35	73	48	47	15	5	22	541	179	7	161	11
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	185	136	80	340	90	19	131	780	252	131	991	66
Arrive On Green	0.15	0.15	0.15	0.15	0.15	0.15	0.59	0.59	0.59	0.59	0.59	0.59
Sat Flow, veh/h	278	883	516	920	580	121	19	1329	429	17	1689	112
Grp Volume(v), veh/h	156	0	0	67	0	0	742	0	0	179	0	0
Grp Sat Flow(s),veh/h/ln	1676	0	0	1621	0	0	1777	0	0	1817	0	0
Q Serve(g_s), s	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	2.6	0.0	0.0	1.0	0.0	0.0	9.1	0.0	0.0	1.4	0.0	0.0
Prop In Lane	0.22		0.31	0.70		0.07	0.03		0.24	0.04		0.06
Lane Grp Cap(c), veh/h	401	0	0	448	0	0	1163	0	0	1188	0	0
V/C Ratio(X)	0.39	0.00	0.00	0.15	0.00	0.00	0.64	0.00	0.00	0.15	0.00	0.00
Avail Cap(c_a), veh/h	1105	0	0	1041	0	0	3201	0	0	3202	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	12.2	0.0	0.0	11.5	0.0	0.0	4.5	0.0	0.0	2.9	0.0	0.0
Incr Delay (d2), s/veh	0.6	0.0	0.0	0.2	0.0	0.0	0.6	0.0	0.0	0.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.3	0.0	0.0	0.5	0.0	0.0	4.5	0.0	0.0	0.7	0.0	0.0
LnGrp Delay(d),s/veh	12.8	0.0	0.0	11.6	0.0	0.0	5.1	0.0	0.0	3.0	0.0	0.0
LnGrp LOS	B			B			A			A		
Approach Vol, veh/h		156			67			742			179	
Approach Delay, s/veh		12.8			11.6			5.1			3.0	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		22.2		8.8		22.2		8.8
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		54.0		18.0		54.0		18.0
Max Q Clear Time (g_c+I1), s		11.1		4.6		3.4		3.0
Green Ext Time (p_c), s		7.1		1.0		7.2		1.0

Intersection Summary	
HCM 2010 Ctrl Delay	6.2
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	32	67	44	43	14	23	20	501	165	59	156	12
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	35	73	48	47	15	25	22	545	179	64	170	13
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	177	141	82	275	78	74	124	796	255	301	722	49
Arrive On Green	0.16	0.16	0.16	0.16	0.16	0.16	0.60	0.60	0.60	0.60	0.60	0.60
Sat Flow, veh/h	267	892	515	667	490	467	19	1331	426	273	1208	82
Grp Volume(v), veh/h	156	0	0	87	0	0	746	0	0	247	0	0
Grp Sat Flow(s),veh/h/ln	1674	0	0	1625	0	0	1777	0	0	1564	0	0
Q Serve(g_s), s	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	2.8	0.0	0.0	1.4	0.0	0.0	9.5	0.0	0.0	2.0	0.0	0.0
Prop In Lane	0.22		0.31	0.54		0.29	0.03		0.24	0.26		0.05
Lane Grp Cap(c), veh/h	400	0	0	426	0	0	1175	0	0	1073	0	0
V/C Ratio(X)	0.39	0.00	0.00	0.20	0.00	0.00	0.63	0.00	0.00	0.23	0.00	0.00
Avail Cap(c_a), veh/h	1038	0	0	982	0	0	3016	0	0	2451	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	12.8	0.0	0.0	12.2	0.0	0.0	4.6	0.0	0.0	3.1	0.0	0.0
Incr Delay (d2), s/veh	0.6	0.0	0.0	0.2	0.0	0.0	0.6	0.0	0.0	0.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.0	0.7	0.0	0.0	4.7	0.0	0.0	1.1	0.0	0.0
LnGrp Delay(d),s/veh	13.4	0.0	0.0	12.5	0.0	0.0	5.1	0.0	0.0	3.2	0.0	0.0
LnGrp LOS	B			B			A			A		
Approach Vol, veh/h		156			87			746			247	
Approach Delay, s/veh		13.4			12.5			5.1			3.2	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		23.6		9.2		23.6		9.2
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		54.0		18.0		54.0		18.0
Max Q Clear Time (g_c+I1), s		11.5		4.8		4.0		3.4
Green Ext Time (p_c), s		8.2		1.1		8.3		1.1

Intersection Summary	
HCM 2010 Ctrl Delay	6.3
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	43	102	59	61	20	7	27	663	286	8	214	16
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	47	111	64	66	22	8	29	721	311	9	233	17
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	123	178	91	266	80	22	80	821	346	77	1122	80
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.67	0.67	0.67	0.67	0.67	0.67
Sat Flow, veh/h	245	958	487	849	428	116	22	1220	515	17	1669	118
Grp Volume(v), veh/h	222	0	0	96	0	0	1061	0	0	259	0	0
Grp Sat Flow(s),veh/h/ln	1690	0	0	1393	0	0	1757	0	0	1805	0	0
Q Serve(g_s), s	3.7	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	6.9	0.0	0.0	3.2	0.0	0.0	28.0	0.0	0.0	3.0	0.0	0.0
Prop In Lane	0.21		0.29	0.69		0.08	0.03		0.29	0.03		0.07
Lane Grp Cap(c), veh/h	392	0	0	367	0	0	1247	0	0	1279	0	0
V/C Ratio(X)	0.57	0.00	0.00	0.26	0.00	0.00	0.85	0.00	0.00	0.20	0.00	0.00
Avail Cap(c_a), veh/h	902	0	0	780	0	0	1430	0	0	1458	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	21.5	0.0	0.0	19.9	0.0	0.0	7.6	0.0	0.0	3.5	0.0	0.0
Incr Delay (d2), s/veh	1.3	0.0	0.0	0.4	0.0	0.0	4.6	0.0	0.0	0.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.3	0.0	0.0	1.3	0.0	0.0	14.9	0.0	0.0	1.5	0.0	0.0
LnGrp Delay(d),s/veh	22.8	0.0	0.0	20.3	0.0	0.0	12.2	0.0	0.0	3.6	0.0	0.0
LnGrp LOS	C			C			B			A		
Approach Vol, veh/h		222			96			1061			259	
Approach Delay, s/veh		22.8			20.3			12.2			3.6	
Approach LOS		C			C			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		42.0		14.5		42.0		14.5
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		44.0		28.0		44.0		28.0
Max Q Clear Time (g_c+I1), s		30.0		8.9		5.0		5.2
Green Ext Time (p_c), s		8.0		1.7		13.5		1.8

Intersection Summary	
HCM 2010 Ctrl Delay	12.7
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	43	102	59	67	21	10	27	664	288	17	216	17
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	47	111	64	73	23	11	29	722	313	18	235	18
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	122	179	91	263	76	27	80	820	348	102	1068	78
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.67	0.67	0.67	0.67	0.67	0.67
Sat Flow, veh/h	246	961	489	844	409	144	22	1218	517	51	1586	116
Grp Volume(v), veh/h	222	0	0	107	0	0	1064	0	0	271	0	0
Grp Sat Flow(s),veh/h/ln	1696	0	0	1396	0	0	1757	0	0	1753	0	0
Q Serve(g_s), s	3.3	0.0	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	6.9	0.0	0.0	3.6	0.0	0.0	28.4	0.0	0.0	3.2	0.0	0.0
Prop In Lane	0.21		0.29	0.68		0.10	0.03		0.29	0.07		0.07
Lane Grp Cap(c), veh/h	393	0	0	367	0	0	1248	0	0	1248	0	0
V/C Ratio(X)	0.57	0.00	0.00	0.29	0.00	0.00	0.85	0.00	0.00	0.22	0.00	0.00
Avail Cap(c_a), veh/h	896	0	0	775	0	0	1420	0	0	1404	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	21.6	0.0	0.0	20.2	0.0	0.0	7.6	0.0	0.0	3.6	0.0	0.0
Incr Delay (d2), s/veh	1.3	0.0	0.0	0.4	0.0	0.0	4.7	0.0	0.0	0.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.4	0.0	0.0	1.5	0.0	0.0	14.9	0.0	0.0	1.6	0.0	0.0
LnGrp Delay(d),s/veh	22.9	0.0	0.0	20.7	0.0	0.0	12.4	0.0	0.0	3.7	0.0	0.0
LnGrp LOS	C			C			B			A		
Approach Vol, veh/h		222			107			1064			271	
Approach Delay, s/veh		22.9			20.7			12.4			3.7	
Approach LOS		C			C			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		42.4		14.6		42.4		14.6
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		44.0		28.0		44.0		28.0
Max Q Clear Time (g_c+I1), s		30.4		8.9		5.2		5.6
Green Ext Time (p_c), s		8.0		1.8		13.8		1.9

Intersection Summary	
HCM 2010 Ctrl Delay	12.9
HCM 2010 LOS	B

HCM 2010 Signalized Intersection Summary
2: Cosgray Rd & Rings Rd

2/2/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	12	7	34	185	64	18	83	222	39	7	547	39
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	13	8	37	201	70	20	90	241	42	8	595	42
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	167	112	285	423	117	28	250	604	93	100	884	62
Arrive On Green	0.27	0.27	0.27	0.27	0.27	0.27	0.52	0.52	0.52	0.52	0.52	0.52
Sat Flow, veh/h	185	413	1053	964	434	103	254	1170	181	6	1712	120
Grp Volume(v), veh/h	58	0	0	291	0	0	373	0	0	645	0	0
Grp Sat Flow(s),veh/h/ln	1650	0	0	1501	0	0	1605	0	0	1837	0	0
Q Serve(g_s), s	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	1.0	0.0	0.0	6.5	0.0	0.0	4.7	0.0	0.0	9.8	0.0	0.0
Prop In Lane	0.22		0.64	0.69		0.07	0.24		0.11	0.01		0.07
Lane Grp Cap(c), veh/h	564	0	0	568	0	0	948	0	0	1046	0	0
V/C Ratio(X)	0.10	0.00	0.00	0.51	0.00	0.00	0.39	0.00	0.00	0.62	0.00	0.00
Avail Cap(c_a), veh/h	1296	0	0	1265	0	0	1853	0	0	2243	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	10.4	0.0	0.0	12.3	0.0	0.0	5.5	0.0	0.0	6.8	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.7	0.0	0.0	0.3	0.0	0.0	0.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.0	0.0	2.8	0.0	0.0	2.3	0.0	0.0	5.0	0.0	0.0
LnGrp Delay(d),s/veh	10.4	0.0	0.0	13.0	0.0	0.0	5.8	0.0	0.0	7.3	0.0	0.0
LnGrp LOS	B			B			A			A		
Approach Vol, veh/h		58			291			373			645	
Approach Delay, s/veh		10.4			13.0			5.8			7.3	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		23.4		14.2		23.4		14.2
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		44.0		28.0		44.0		28.0
Max Q Clear Time (g_c+I1), s		6.7		3.0		11.8		8.5
Green Ext Time (p_c), s		7.8		2.1		7.6		1.9

Intersection Summary	
HCM 2010 Ctrl Delay	8.3
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	14	7	34	185	64	77	83	231	39	42	552	40
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	15	8	37	201	70	84	90	251	42	46	600	43
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	179	116	313	365	112	109	228	586	88	118	838	58
Arrive On Green	0.30	0.30	0.30	0.30	0.30	0.30	0.52	0.52	0.52	0.52	0.52	0.52
Sat Flow, veh/h	258	381	1028	785	369	358	250	1133	170	64	1621	112
Grp Volume(v), veh/h	60	0	0	355	0	0	383	0	0	689	0	0
Grp Sat Flow(s),veh/h/ln	1667	0	0	1512	0	0	1553	0	0	1797	0	0
Q Serve(g_s), s	0.0	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0
Cycle Q Clear(g_c), s	1.2	0.0	0.0	9.5	0.0	0.0	5.8	0.0	0.0	13.1	0.0	0.0
Prop In Lane	0.25		0.62	0.57		0.24	0.23		0.11	0.07		0.06
Lane Grp Cap(c), veh/h	608	0	0	586	0	0	902	0	0	1015	0	0
V/C Ratio(X)	0.10	0.00	0.00	0.61	0.00	0.00	0.42	0.00	0.00	0.68	0.00	0.00
Avail Cap(c_a), veh/h	1088	0	0	1060	0	0	1544	0	0	1829	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	11.2	0.0	0.0	14.1	0.0	0.0	6.6	0.0	0.0	8.4	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	1.0	0.0	0.0	0.3	0.0	0.0	0.8	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.0	0.0	4.1	0.0	0.0	3.0	0.0	0.0	6.7	0.0	0.0
LnGrp Delay(d),s/veh	11.3	0.0	0.0	15.1	0.0	0.0	6.9	0.0	0.0	9.2	0.0	0.0
LnGrp LOS	B			B			A			A		
Approach Vol, veh/h		60			355			383			689	
Approach Delay, s/veh		11.3			15.1			6.9			9.2	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		27.2		17.7		27.2		17.7
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		44.0		28.0		44.0		28.0
Max Q Clear Time (g_c+I1), s		7.8		3.2		15.1		11.5
Green Ext Time (p_c), s		8.5		2.6		8.1		2.3

Intersection Summary	
HCM 2010 Ctrl Delay	10.1
HCM 2010 LOS	B

HCM 2010 Signalized Intersection Summary
2: Cosgray Rd & Rings Rd

2/2/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	18	11	45	293	95	24	110	307	64	9	730	53
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	20	12	49	318	103	26	120	334	70	10	793	58
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	170	120	343	448	116	29	168	443	84	56	927	67
Arrive On Green	0.34	0.34	0.34	0.34	0.34	0.34	0.54	0.54	0.54	0.54	0.54	0.54
Sat Flow, veh/h	307	351	1007	1051	341	86	192	816	155	7	1706	124
Grp Volume(v), veh/h	81	0	0	447	0	0	524	0	0	861	0	0
Grp Sat Flow(s),veh/h/ln	1664	0	0	1478	0	0	1164	0	0	1837	0	0
Q Serve(g_s), s	0.0	0.0	0.0	17.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Cycle Q Clear(g_c), s	2.3	0.0	0.0	19.6	0.0	0.0	27.5	0.0	0.0	27.7	0.0	0.0
Prop In Lane	0.25		0.60	0.71		0.06	0.23		0.13	0.01		0.07
Lane Grp Cap(c), veh/h	633	0	0	593	0	0	696	0	0	1050	0	0
V/C Ratio(X)	0.13	0.00	0.00	0.75	0.00	0.00	0.75	0.00	0.00	0.82	0.00	0.00
Avail Cap(c_a), veh/h	753	0	0	708	0	0	799	0	0	1197	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	15.7	0.0	0.0	21.2	0.0	0.0	11.7	0.0	0.0	13.5	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	3.8	0.0	0.0	3.5	0.0	0.0	4.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	0.0	8.6	0.0	0.0	9.1	0.0	0.0	15.1	0.0	0.0
LnGrp Delay(d),s/veh	15.8	0.0	0.0	25.0	0.0	0.0	15.2	0.0	0.0	17.7	0.0	0.0
LnGrp LOS	B			C			B			B		
Approach Vol, veh/h		81			447			524			861	
Approach Delay, s/veh		15.8			25.0			15.2			17.7	
Approach LOS		B			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		41.4		27.5		41.4		27.5
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		43.0		29.0		43.0		29.0
Max Q Clear Time (g_c+I1), s		29.5		4.3		29.7		21.6
Green Ext Time (p_c), s		7.8		3.5		7.8		1.9

Intersection Summary	
HCM 2010 Ctrl Delay	18.6
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	19	12	45	297	96	34	110	310	70	15	732	54
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	21	13	49	323	104	37	120	337	76	16	796	59
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	172	123	337	437	114	41	162	432	89	57	928	68
Arrive On Green	0.34	0.34	0.34	0.34	0.34	0.34	0.55	0.55	0.55	0.55	0.55	0.55
Sat Flow, veh/h	322	358	980	1030	332	118	186	789	162	13	1696	124
Grp Volume(v), veh/h	83	0	0	464	0	0	533	0	0	871	0	0
Grp Sat Flow(s),veh/h/ln	1660	0	0	1480	0	0	1137	0	0	1833	0	0
Q Serve(g_s), s	0.0	0.0	0.0	19.4	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	2.5	0.0	0.0	21.8	0.0	0.0	31.3	0.0	0.0	29.8	0.0	0.0
Prop In Lane	0.25		0.59	0.70		0.08	0.23		0.14	0.02		0.07
Lane Grp Cap(c), veh/h	632	0	0	592	0	0	683	0	0	1053	0	0
V/C Ratio(X)	0.13	0.00	0.00	0.78	0.00	0.00	0.78	0.00	0.00	0.83	0.00	0.00
Avail Cap(c_a), veh/h	691	0	0	648	0	0	752	0	0	1151	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	16.6	0.0	0.0	22.7	0.0	0.0	12.8	0.0	0.0	14.2	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	5.8	0.0	0.0	4.9	0.0	0.0	4.8	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	0.0	9.8	0.0	0.0	10.3	0.0	0.0	16.4	0.0	0.0
LnGrp Delay(d),s/veh	16.7	0.0	0.0	28.5	0.0	0.0	17.7	0.0	0.0	19.0	0.0	0.0
LnGrp LOS	B			C			B			B		
Approach Vol, veh/h		83			464			533			871	
Approach Delay, s/veh		16.7			28.5			17.7			19.0	
Approach LOS		B			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		44.1		29.2		44.1		29.2
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		44.0		28.0		44.0		28.0
Max Q Clear Time (g_c+I1), s		33.3		4.5		31.8		23.8
Green Ext Time (p_c), s		6.7		3.6		7.4		1.3

Intersection Summary	
HCM 2010 Ctrl Delay	20.8
HCM 2010 LOS	C

MOVEMENT SUMMARY

Site: 2015 AM No Build

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2015 AM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	22	3.0	0.604	13.3	LOS B	5.7	146.7	0.51	0.85	31.9
8	T	541	3.0	0.604	6.1	LOS A	5.7	146.7	0.51	0.48	35.1
18	R	179	3.0	0.604	7.0	LOS A	5.7	146.7	0.51	0.54	34.2
Approach		742	3.0	0.604	6.6	LOS A	5.7	146.7	0.51	0.50	34.8
East: Rings Road											
1	L	47	3.0	0.099	13.9	LOS B	0.6	14.2	0.68	0.80	22.8
6	T	15	3.0	0.099	4.6	LOS A	0.6	14.2	0.68	0.57	22.7
16	R	5	3.0	0.099	6.3	LOS A	0.6	14.2	0.68	0.63	23.9
Approach		67	3.0	0.099	11.2	LOS B	0.6	14.2	0.68	0.73	22.9
North: Cosgray Road											
7	L	7	3.0	0.151	11.0	LOS B	0.9	21.9	0.27	0.94	31.8
4	T	161	3.0	0.151	5.5	LOS A	0.9	21.9	0.27	0.41	36.9
14	R	11	3.0	0.151	6.2	LOS A	0.9	21.9	0.27	0.52	35.5
Approach		178	3.0	0.151	5.7	LOS A	0.9	21.9	0.27	0.43	36.7
West: Rings Road											
5	L	35	3.0	0.155	13.9	LOS B	0.8	20.8	0.42	0.78	28.4
2	T	73	3.0	0.155	3.7	LOS A	0.8	20.8	0.42	0.40	29.7
12	R	48	3.0	0.155	6.4	LOS A	0.8	20.8	0.42	0.52	30.5
Approach		155	3.0	0.155	6.8	LOS A	0.8	20.8	0.42	0.52	29.6
All Vehicles		1143	3.0	0.604	6.7	LOS A	5.7	146.7	0.47	0.51	33.2

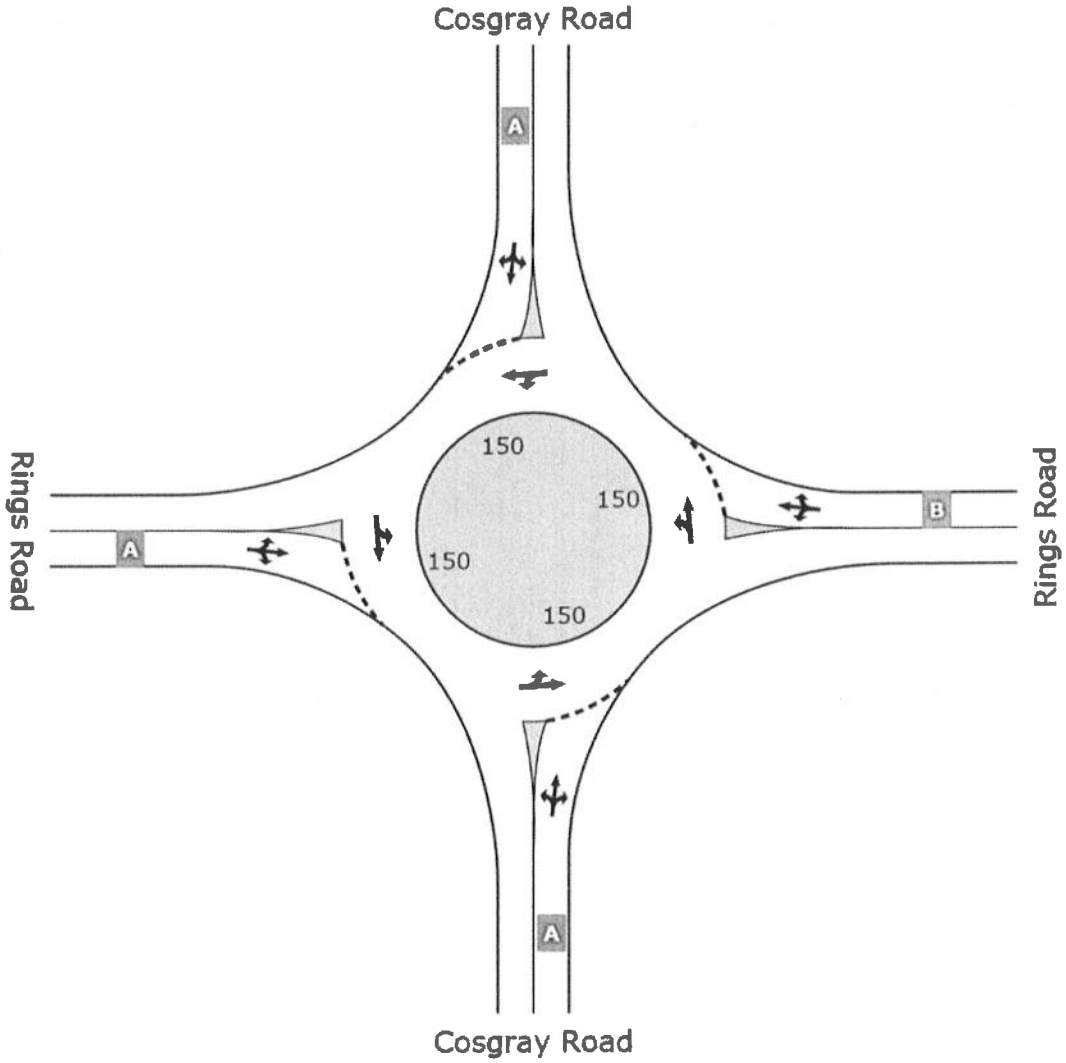
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2015 AM No Build

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2015 AM No Build
Roundabout



	South	East	North	West	Intersection
LOS	A	B	A	A	A

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2015 AM Build

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2015 AM Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	22	3.0	0.657	14.1	LOS B	6.3	160.6	0.65	0.84	31.6
8	T	545	3.0	0.657	6.9	LOS A	6.3	160.6	0.65	0.55	34.2
18	R	179	3.0	0.657	7.8	LOS A	6.3	160.6	0.65	0.61	33.5
Approach		746	3.0	0.657	7.3	LOS A	6.3	160.6	0.65	0.57	34.0
East: Rings Road											
1	L	47	3.0	0.131	14.0	LOS B	0.8	19.7	0.71	0.83	22.8
6	T	15	3.0	0.131	4.7	LOS A	0.8	19.7	0.71	0.61	22.6
16	R	25	3.0	0.131	6.5	LOS A	0.8	19.7	0.71	0.67	23.9
Approach		87	3.0	0.131	10.2	LOS B	0.8	19.7	0.71	0.74	23.1
North: Cosgray Road											
7	L	64	3.0	0.206	11.0	LOS B	1.2	31.4	0.29	0.89	31.7
4	T	170	3.0	0.206	5.5	LOS A	1.2	31.4	0.29	0.39	36.6
14	R	13	3.0	0.206	6.2	LOS A	1.2	31.4	0.29	0.49	35.2
Approach		247	3.0	0.206	7.0	LOS A	1.2	31.4	0.29	0.53	35.2
West: Rings Road											
5	L	35	3.0	0.165	14.3	LOS B	0.9	22.4	0.48	0.79	28.2
2	T	73	3.0	0.165	4.1	LOS A	0.9	22.4	0.48	0.45	29.4
12	R	48	3.0	0.165	6.8	LOS A	0.9	22.4	0.48	0.56	30.3
Approach		155	3.0	0.165	7.2	LOS A	0.9	22.4	0.48	0.56	29.4
All Vehicles		1235	3.0	0.657	7.4	LOS A	6.3	160.6	0.56	0.58	32.4

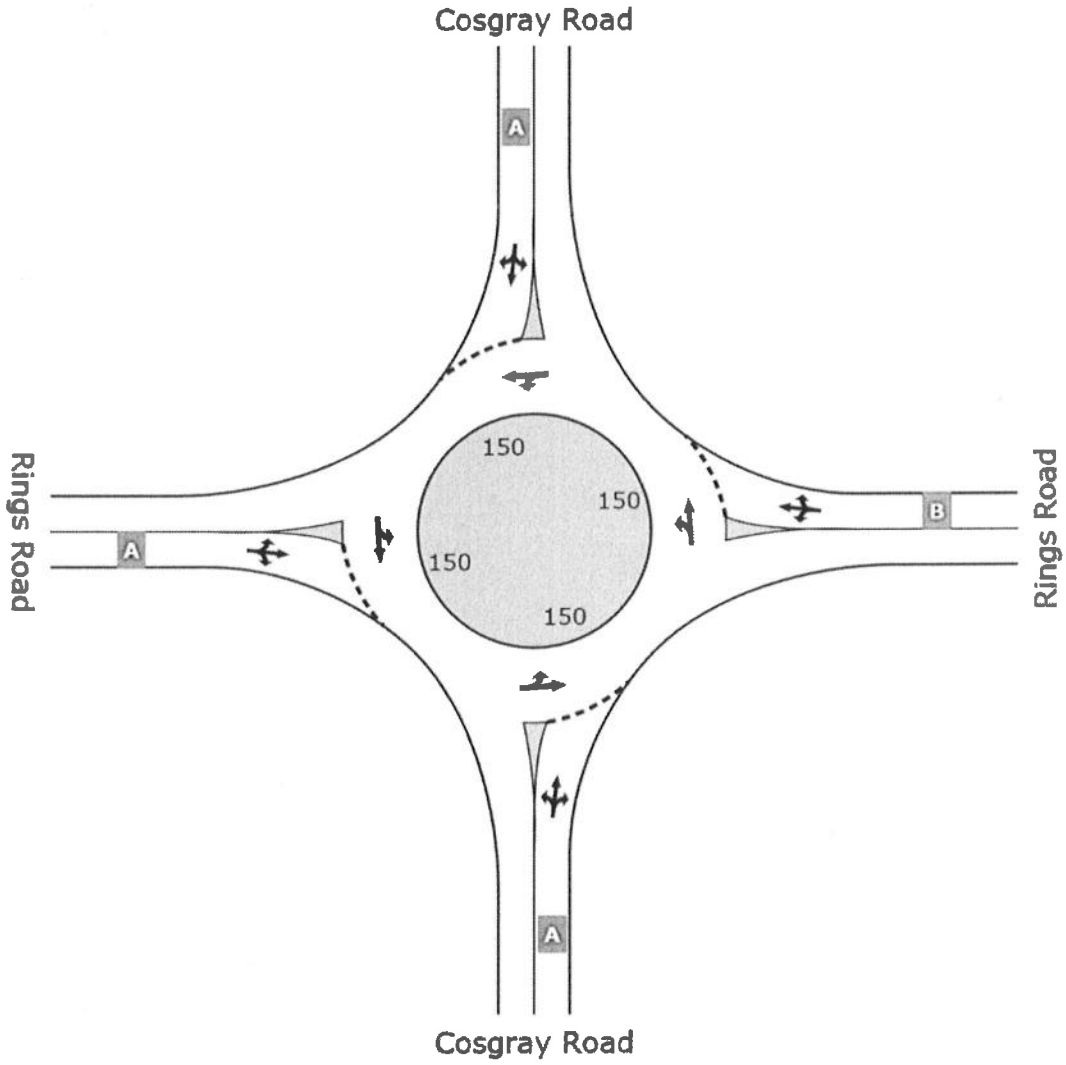
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2015 AM Build

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2015 AM Build
Roundabout



	South	East	North	West	Intersection
LOS	A	B	A	A	A

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 AM No Build 1

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 AM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	29	3.0	0.913	20.4	LOS C	23.0	589.2	1.00	0.81	28.4
8	T	721	3.0	0.913	13.3	LOS B	23.0	589.2	1.00	0.81	31.5
18	R	311	3.0	0.913	14.2	LOS B	23.0	589.2	1.00	0.81	30.2
Approach		1061	3.0	0.913	13.7	LOS B	23.0	589.2	1.00	0.81	31.0
East: Rings Road											
1	L	66	3.0	0.208	16.3	LOS B	1.4	35.5	0.88	0.91	22.1
6	T	22	3.0	0.208	7.0	LOS A	1.4	35.5	0.88	0.82	21.9
16	R	8	3.0	0.208	8.7	LOS A	1.4	35.5	0.88	0.85	23.1
Approach		96	3.0	0.208	13.6	LOS B	1.4	35.5	0.88	0.88	22.1
North: Cosgray Road											
7	L	9	3.0	0.228	11.3	LOS B	1.4	36.2	0.36	0.91	31.7
4	T	233	3.0	0.228	5.7	LOS A	1.4	36.2	0.36	0.44	36.3
14	R	17	3.0	0.228	6.5	LOS A	1.4	36.2	0.36	0.54	35.1
Approach		259	3.0	0.228	6.0	LOS A	1.4	36.2	0.36	0.46	36.1
West: Rings Road											
5	L	47	3.0	0.241	14.6	LOS B	1.4	35.0	0.53	0.81	28.1
2	T	111	3.0	0.241	4.5	LOS A	1.4	35.0	0.53	0.49	29.1
12	R	64	3.0	0.241	7.2	LOS A	1.4	35.0	0.53	0.60	30.1
Approach		222	3.0	0.241	7.4	LOS A	1.4	35.0	0.53	0.59	29.1
All Vehicles		1637	3.0	0.913	11.6	LOS B	23.0	589.2	0.83	0.73	30.7

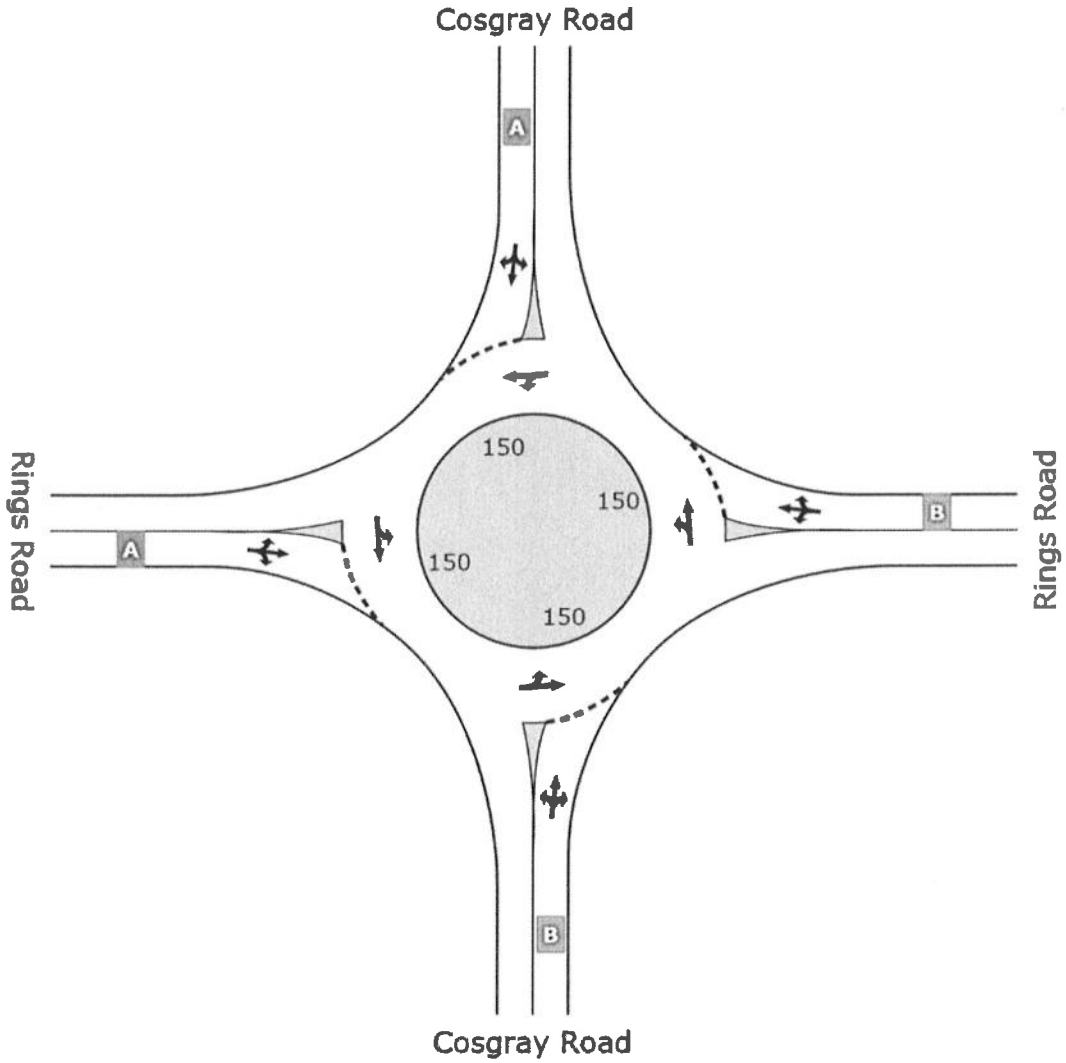
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 AM No Build 1

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 AM No Build
Roundabout



	South	East	North	West	Intersection
LOS	B	B	A	A	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 AM No Build 2

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 AM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	29	3.0	0.911	20.2	LOS C	22.5	577.0	1.00	0.81	28.5
8	T	721	3.0	0.911	13.1	LOS B	22.5	577.0	1.00	0.80	31.6
18	R	311	3.0	0.911	14.0	LOS B	22.5	577.0	1.00	0.81	30.3
Approach		1061	3.0	0.911	13.5	LOS B	22.5	577.0	1.00	0.80	31.2
East:											
1	L	66	3.0	0.208	16.3	LOS B	1.4	35.5	0.88	0.91	22.1
6	T	22	3.0	0.208	7.0	LOS A	1.4	35.5	0.88	0.82	21.9
16	R	8	3.0	0.208	8.7	LOS A	1.4	35.5	0.88	0.85	23.1
Approach		96	3.0	0.208	13.6	LOS B	1.4	35.5	0.88	0.88	22.2
North: Cosgray Road											
7	L	9	3.0	0.102	11.0	LOS B	0.6	14.6	0.31	0.90	31.8
4	T	233	3.0	0.102	5.8	LOS A	0.6	14.8	0.31	0.43	36.5
14	R	17	3.0	0.102	6.4	LOS A	0.6	14.8	0.30	0.53	35.2
Approach		259	3.0	0.102	6.0	LOS A	0.6	14.8	0.31	0.45	36.2
West: Rings Road											
5	L	47	3.0	0.258	14.3	LOS B	1.1	29.2	0.46	0.85	28.3
2	T	111	3.0	0.258	4.1	LOS A	1.1	29.2	0.46	0.45	29.5
12	R	64	3.0	0.258	6.6	LOS A	1.1	29.2	0.46	0.57	30.4
Approach		222	3.0	0.258	7.0	LOS A	1.1	29.2	0.46	0.57	29.5
All Vehicles		1637	3.0	0.911	11.5	LOS B	22.5	577.0	0.81	0.72	30.8

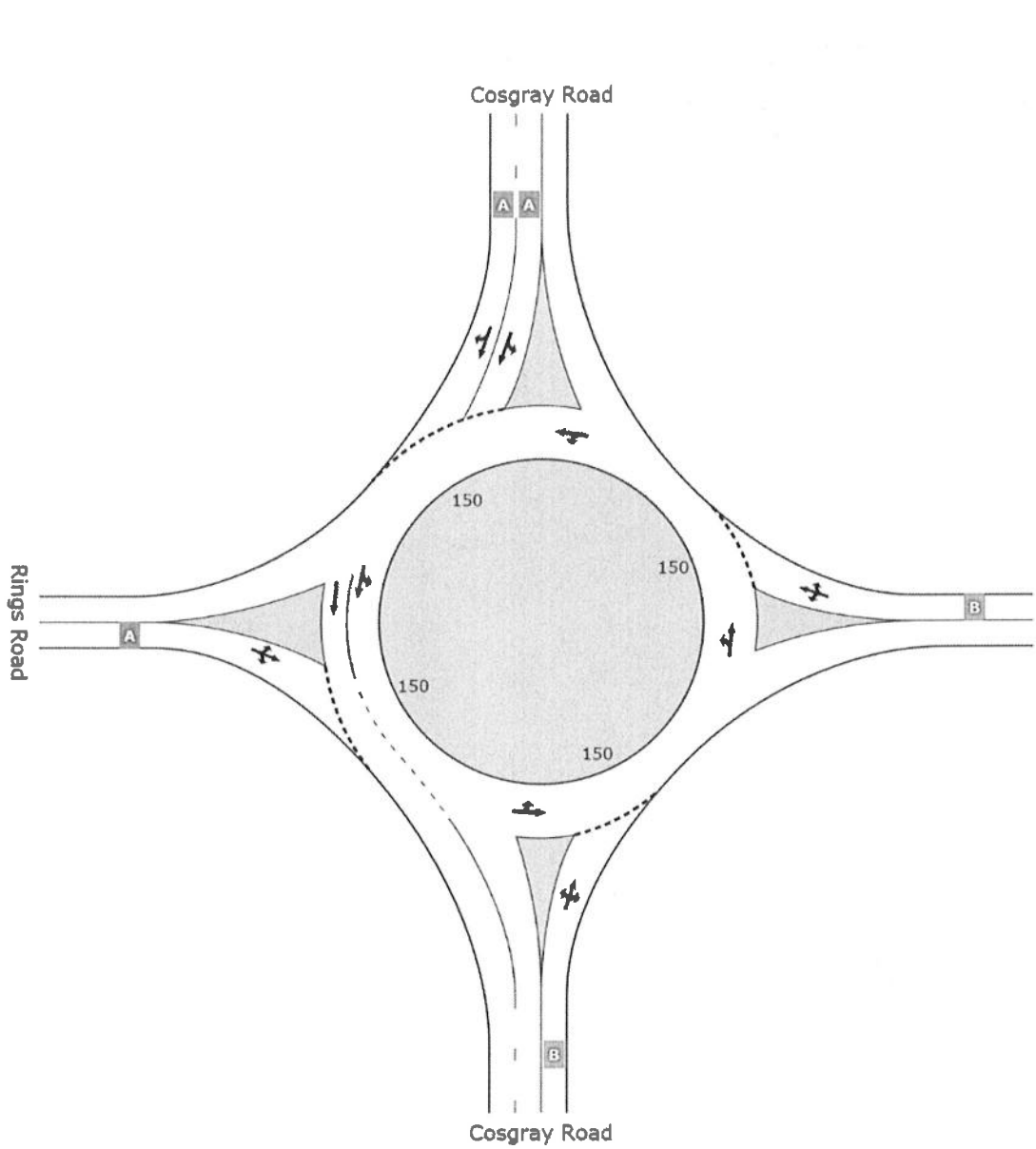
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 AM No Build 2

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 AM No Build
Roundabout



	South	East	North	West	Intersection
LOS	B	B	A	A	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 AM Build 1

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 AM Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	29	3.0	0.928	22.2	LOS C	25.3	648.2	1.00	0.86	27.4
8	T	722	3.0	0.928	15.1	LOS B	25.3	648.2	1.00	0.86	30.3
18	R	313	3.0	0.928	16.0	LOS B	25.3	648.2	1.00	0.86	28.9
Approach		1064	3.0	0.928	15.6	LOS B	25.3	648.2	1.00	0.86	29.8
East:											
1	L	73	3.0	0.232	16.4	LOS B	1.6	39.9	0.89	0.92	22.1
6	T	23	3.0	0.232	7.0	LOS A	1.6	39.9	0.89	0.84	21.9
16	R	11	3.0	0.232	8.8	LOS A	1.6	39.9	0.89	0.86	23.0
Approach		107	3.0	0.232	13.6	LOS B	1.6	39.9	0.89	0.90	22.1
North: Cosgray Road											
7	L	18	3.0	0.242	11.3	LOS B	1.5	38.9	0.38	0.90	31.7
4	T	235	3.0	0.242	5.8	LOS A	1.5	38.9	0.38	0.45	36.2
14	R	18	3.0	0.242	6.5	LOS A	1.5	38.9	0.38	0.54	35.0
Approach		272	3.0	0.242	6.2	LOS A	1.5	38.9	0.38	0.49	35.8
West: Rings Road											
5	L	47	3.0	0.245	14.8	LOS B	1.4	35.8	0.55	0.82	28.0
2	T	111	3.0	0.245	4.6	LOS A	1.4	35.8	0.55	0.51	29.0
12	R	64	3.0	0.245	7.3	LOS A	1.4	35.8	0.55	0.61	30.0
Approach		222	3.0	0.245	7.5	LOS A	1.4	35.8	0.55	0.60	29.1
All Vehicles		1664	3.0	0.928	12.8	LOS B	25.3	648.2	0.83	0.77	29.8

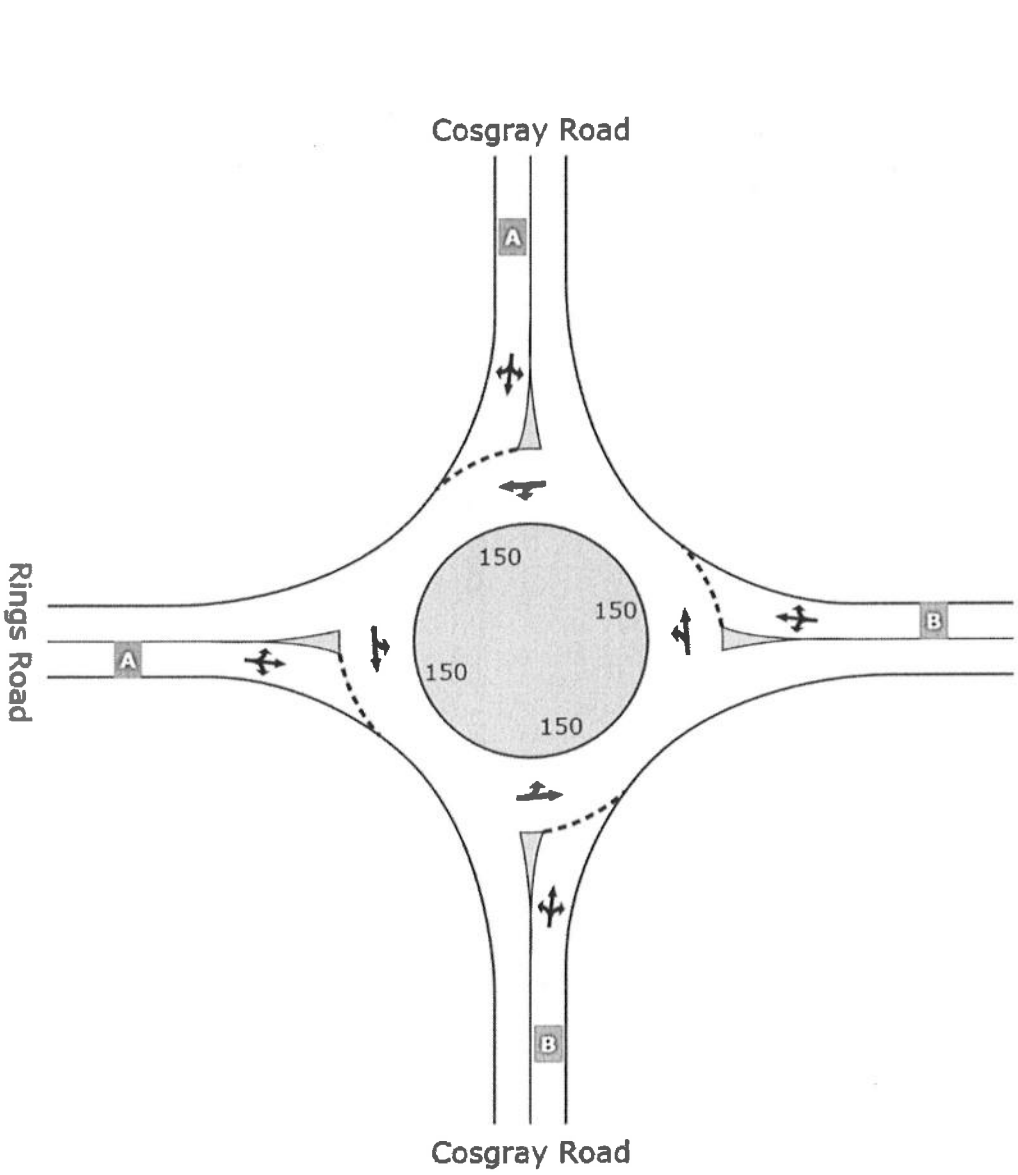
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 AM Build 1

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 AM Build
Roundabout



	South	East	North	West	Intersection
LOS	B	B	A	A	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 AM Build 2

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 AM Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	29	3.0	0.925	22.0	LOS C	24.8	634.4	1.00	0.86	27.5
8	T	722	3.0	0.925	14.9	LOS B	24.8	634.4	1.00	0.86	30.4
18	R	313	3.0	0.925	15.7	LOS B	24.8	634.4	1.00	0.86	29.0
Approach		1064	3.0	0.925	15.3	LOS B	24.8	634.4	1.00	0.86	30.0
East:											
1	L	73	3.0	0.232	16.4	LOS B	1.6	39.9	0.89	0.92	22.1
6	T	23	3.0	0.232	7.0	LOS A	1.6	39.9	0.89	0.84	21.9
16	R	11	3.0	0.232	8.8	LOS A	1.6	39.9	0.89	0.86	23.1
Approach		107	3.0	0.232	13.6	LOS B	1.6	39.9	0.89	0.90	22.2
North: Cosgray Road											
7	L	18	3.0	0.108	11.0	LOS B	0.6	15.6	0.33	0.88	31.8
4	T	235	3.0	0.108	5.8	LOS A	0.6	15.8	0.32	0.43	36.4
14	R	18	3.0	0.108	6.5	LOS A	0.6	15.8	0.32	0.53	35.1
Approach		272	3.0	0.108	6.2	LOS A	0.6	15.8	0.32	0.47	35.9
West: Rings Road											
5	L	47	3.0	0.261	14.4	LOS B	1.2	29.6	0.47	0.85	28.2
2	T	111	3.0	0.261	4.2	LOS A	1.2	29.6	0.47	0.46	29.5
12	R	64	3.0	0.261	6.7	LOS A	1.2	29.6	0.47	0.58	30.4
Approach		222	3.0	0.261	7.1	LOS A	1.2	29.6	0.47	0.58	29.4
All Vehicles		1664	3.0	0.925	12.6	LOS B	24.8	634.4	0.81	0.76	30.0

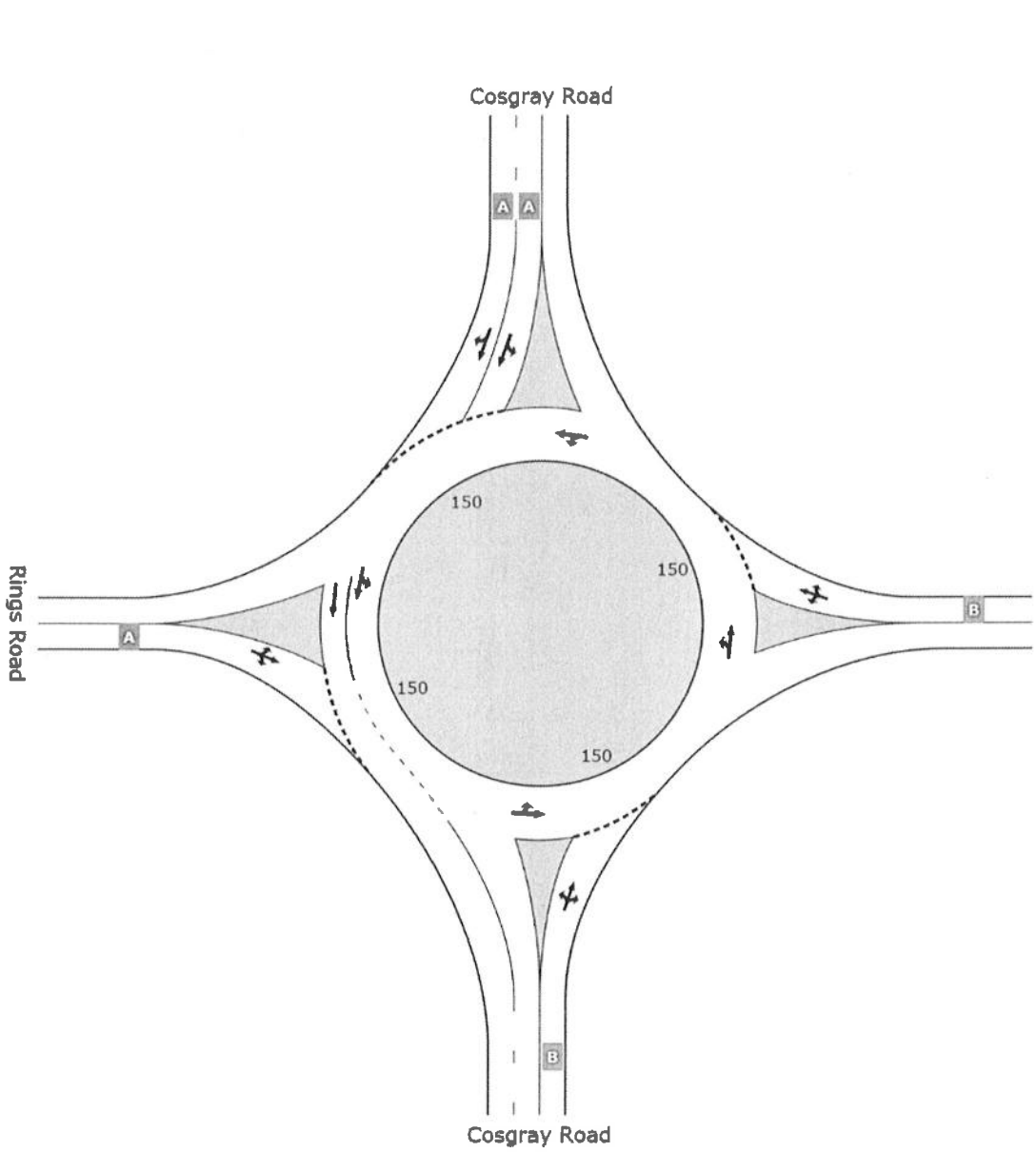
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 AM Build 2

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 AM Build
Roundabout



	South	East	North	West	Intersection
LOS	B	B	A	A	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2015 PM No Build

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2015 PM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	90	3.0	0.266	12.3	LOS B	1.8	45.7	0.16	0.91	31.6
8	T	241	3.0	0.266	5.1	LOS A	1.8	45.7	0.16	0.35	37.6
18	R	42	3.0	0.266	6.0	LOS A	1.8	45.7	0.16	0.46	36.4
Approach		374	3.0	0.266	7.0	LOS A	1.8	45.7	0.16	0.50	35.8
East:											
1	L	201	3.0	0.323	12.5	LOS B	1.9	48.8	0.58	0.79	23.3
6	T	70	3.0	0.323	3.2	LOS A	1.9	48.8	0.58	0.46	23.1
16	R	20	3.0	0.323	4.9	LOS A	1.9	48.8	0.58	0.56	24.2
Approach		290	3.0	0.323	9.7	LOS A	1.9	48.8	0.58	0.69	23.3
North: Cosgray Road											
7	L	8	3.0	0.725	17.7	LOS B	8.9	228.6	0.88	1.00	28.5
4	T	595	3.0	0.725	12.1	LOS B	8.9	228.6	0.88	0.91	32.6
14	R	42	3.0	0.725	12.9	LOS B	8.9	228.6	0.88	0.93	31.8
Approach		645	3.0	0.725	12.3	LOS B	8.9	228.6	0.88	0.92	32.5
West: Rings Road											
5	L	13	3.0	0.113	18.7	LOS B	0.7	17.9	0.81	0.87	26.3
2	T	8	3.0	0.113	8.5	LOS A	0.7	17.9	0.81	0.76	27.1
12	R	37	3.0	0.113	11.3	LOS B	0.7	17.9	0.81	0.79	28.3
Approach		58	3.0	0.113	12.6	LOS B	0.7	17.9	0.81	0.81	27.7
All Vehicles		1366	3.0	0.725	10.3	LOS B	8.9	228.6	0.62	0.75	30.4

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

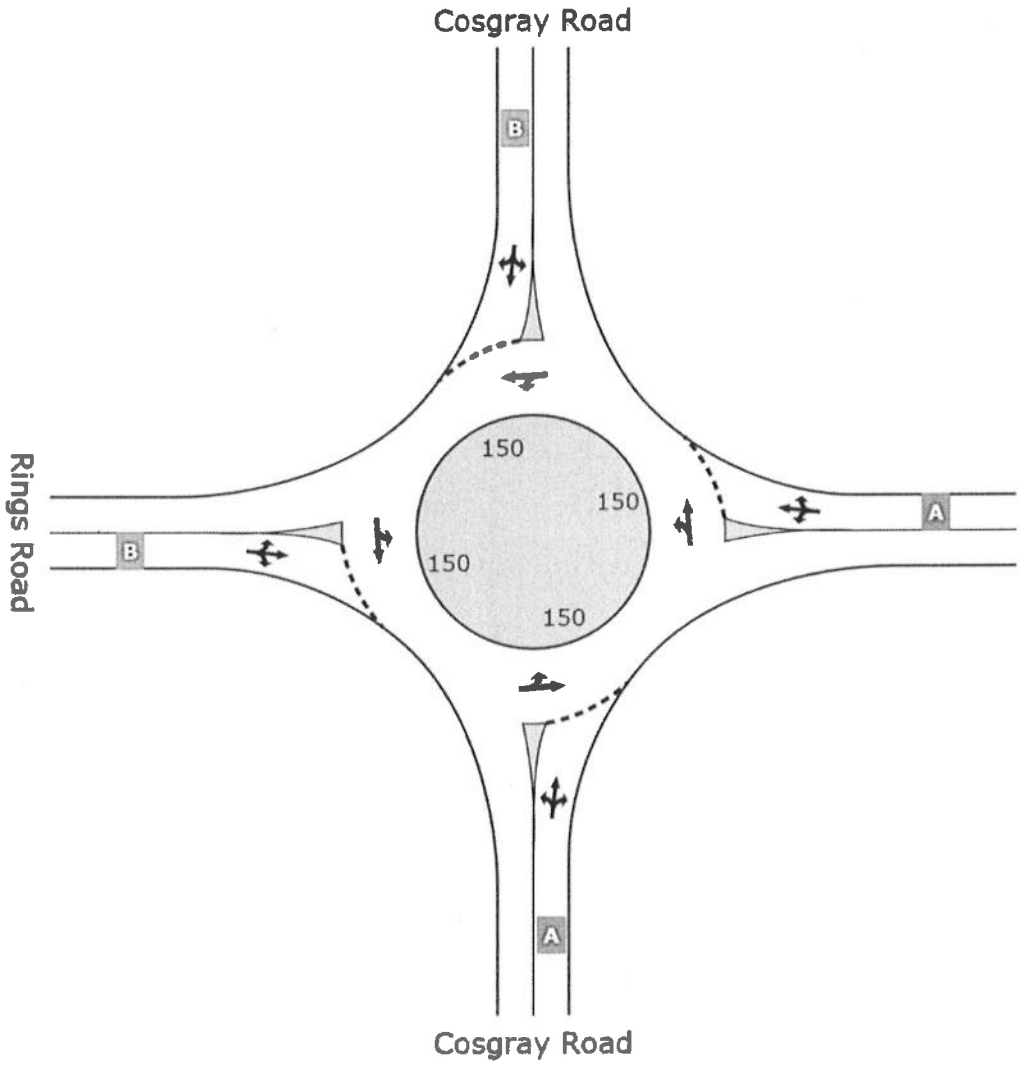
Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

SIDRA INTERSECTION

LEVEL OF SERVICE SUMMARY

Site: 2015 PM No Build

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2015 PM No Build
Roundabout



	South	East	North	West	Intersection
LOS	A	A	B	B	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2015 PM Build

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2015 PM Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	90	3.0	0.302	12.6	LOS B	2.1	52.9	0.28	0.87	31.6
8	T	251	3.0	0.302	5.4	LOS A	2.1	52.9	0.28	0.39	36.6
18	R	42	3.0	0.302	6.3	LOS A	2.1	52.9	0.28	0.48	35.6
Approach		384	3.0	0.302	7.2	LOS A	2.1	52.9	0.28	0.51	35.2
East:											
1	L	201	3.0	0.402	12.8	LOS B	2.6	66.0	0.64	0.81	23.2
6	T	70	3.0	0.402	3.5	LOS A	2.6	66.0	0.64	0.50	22.9
16	R	84	3.0	0.402	5.2	LOS A	2.6	66.0	0.64	0.60	24.1
Approach		354	3.0	0.402	9.2	LOS A	2.6	66.0	0.64	0.70	23.3
North: Cosgray Road											
7	L	46	3.0	0.774	19.1	LOS B	10.9	279.1	0.93	1.03	27.7
4	T	600	3.0	0.774	13.5	LOS B	10.9	279.1	0.93	0.98	31.5
14	R	43	3.0	0.774	14.3	LOS B	10.9	279.1	0.93	0.99	30.7
Approach		689	3.0	0.774	14.0	LOS B	10.9	279.1	0.93	0.98	31.2
West: Rings Road											
5	L	15	3.0	0.128	19.4	LOS B	0.8	20.7	0.85	0.89	26.0
2	T	8	3.0	0.128	9.2	LOS A	0.8	20.7	0.85	0.79	26.7
12	R	37	3.0	0.128	11.9	LOS B	0.8	20.7	0.85	0.82	27.9
Approach		60	3.0	0.128	13.4	LOS B	0.8	20.7	0.85	0.83	27.3
All Vehicles		1487	3.0	0.774	11.1	LOS B	10.9	279.1	0.69	0.79	29.4

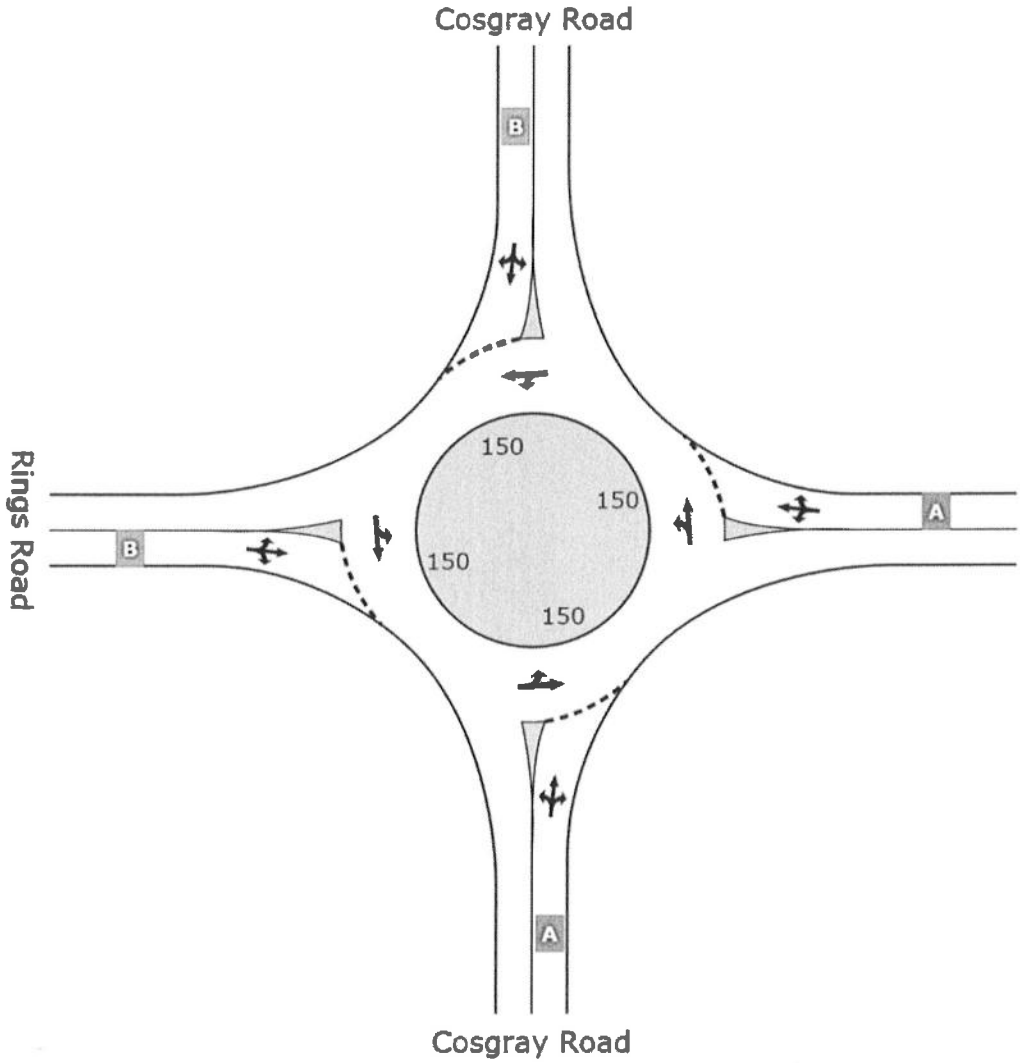
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2015 PM Build

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2015 PM Build
Roundabout



	South	East	North	West	Intersection
LOS	A	A	B	B	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 PM No Build 1

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 PM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	120	3.0	0.377	12.4	LOS B	3.0	76.0	0.23	0.88	31.6
8	T	334	3.0	0.377	5.2	LOS A	3.0	76.0	0.23	0.36	37.1
18	R	70	3.0	0.377	6.1	LOS A	3.0	76.0	0.23	0.46	36.0
Approach		523	3.0	0.377	7.0	LOS A	3.0	76.0	0.23	0.49	35.5
East:											
1	L	318	3.0	0.560	15.8	LOS B	4.7	120.5	0.78	0.97	22.2
6	T	103	3.0	0.560	6.5	LOS A	4.7	120.5	0.78	0.82	22.2
16	R	26	3.0	0.560	8.2	LOS A	4.7	120.5	0.78	0.86	23.3
Approach		448	3.0	0.560	13.2	LOS B	4.7	120.5	0.78	0.93	22.3
North: Cosgray Road											
7	L	10	3.0	1.196	118.4	LOS F	65.5	1676.1	1.00	2.66	9.2
4	T	793	3.0	1.196	112.9	LOS F	65.5	1676.1	1.00	2.66	10.0
14	R	58	3.0	1.196	113.6	LOS F	65.5	1676.1	1.00	2.66	9.2
Approach		861	3.0	1.196	113.0	LOS F	65.5	1676.1	1.00	2.66	9.9
West: Rings Road											
5	L	20	3.0	0.210	22.1	LOS C	1.4	35.6	0.92	0.96	25.0
2	T	12	3.0	0.210	11.9	LOS B	1.4	35.6	0.92	0.90	25.2
12	R	49	3.0	0.210	14.7	LOS B	1.4	35.6	0.92	0.92	26.5
Approach		80	3.0	0.210	16.1	LOS B	1.4	35.6	0.92	0.93	25.9
All Vehicles		1912	3.0	1.196	56.6	LOS E	65.5	1676.1	0.74	1.59	15.4

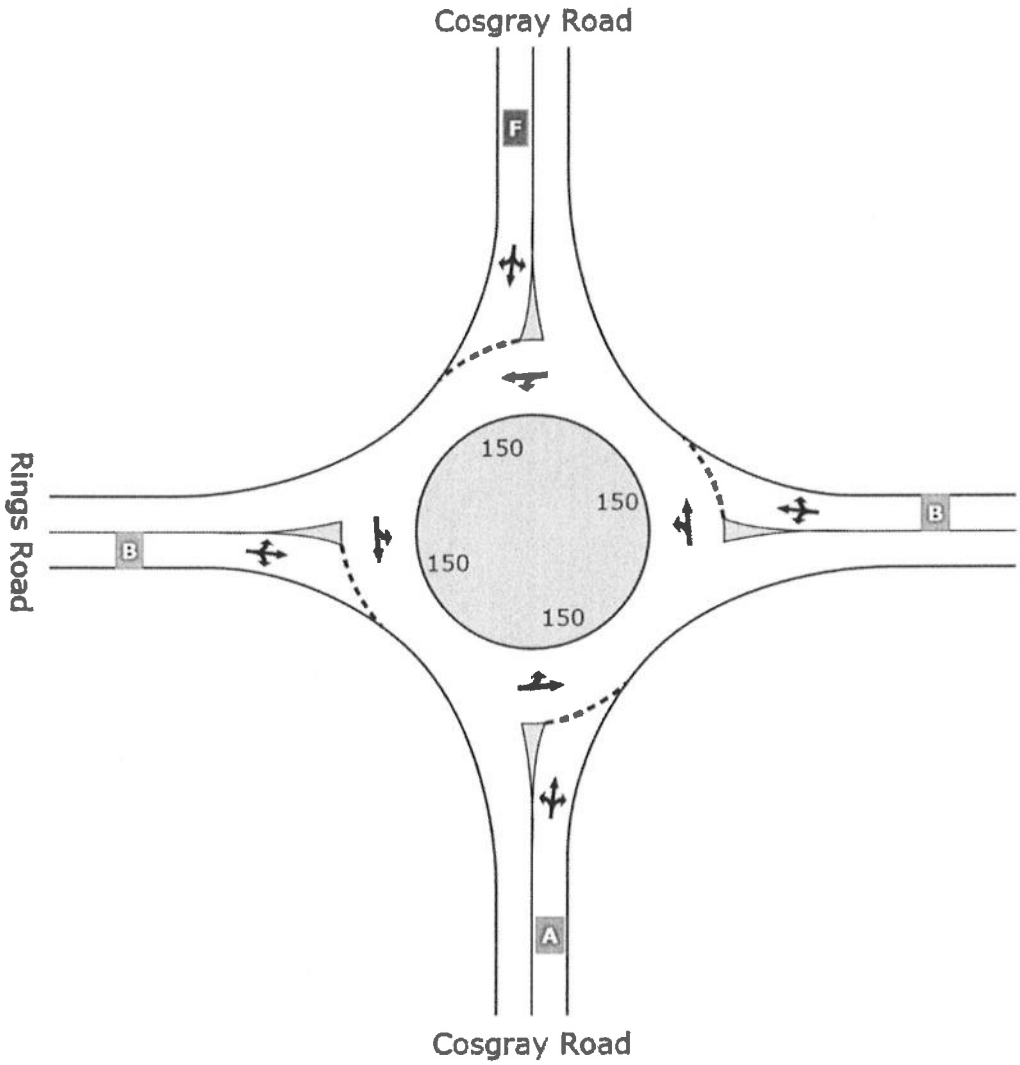
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 PM No Build 1

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 PM No Build
Roundabout



	South	East	North	West	Intersection
LOS	A	B	F	B	E

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 PM No Build 2

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 PM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	120	3.0	0.378	12.4	LOS B	2.9	73.2	0.23	0.88	31.6
8	T	334	3.0	0.378	5.2	LOS A	2.9	73.2	0.23	0.36	37.1
18	R	70	3.0	0.378	6.1	LOS A	2.9	73.2	0.23	0.46	36.0
Approach		523	3.0	0.378	7.0	LOS A	2.9	73.2	0.23	0.50	35.5
East:											
1	L	318	3.0	0.559	15.8	LOS B	4.7	120.4	0.78	0.97	22.3
6	T	103	3.0	0.559	6.5	LOS A	4.7	120.4	0.78	0.82	22.2
16	R	26	3.0	0.559	8.2	LOS A	4.7	120.4	0.78	0.86	23.3
Approach		448	3.0	0.559	13.2	LOS B	4.7	120.4	0.78	0.93	22.3
North: Cosgray Road											
7	L	10	3.0	0.508	15.7	LOS B	4.2	106.6	0.83	0.99	29.5
4	T	793	3.0	0.508	10.0	LOS B	4.3	110.5	0.82	0.82	33.2
14	R	58	3.0	0.508	10.2	LOS B	4.3	110.5	0.82	0.85	33.0
Approach		861	3.0	0.508	10.1	LOS B	4.3	110.5	0.82	0.83	33.2
West: Rings Road											
5	L	20	3.0	0.177	17.9	LOS B	0.8	20.4	0.73	0.96	26.7
2	T	12	3.0	0.177	7.7	LOS A	0.8	20.4	0.73	0.79	27.7
12	R	49	3.0	0.177	10.3	LOS B	0.8	20.4	0.73	0.84	28.9
Approach		80	3.0	0.177	11.7	LOS B	0.8	20.4	0.73	0.86	28.1
All Vehicles		1912	3.0	0.559	10.1	LOS B	4.7	120.4	0.65	0.76	29.9

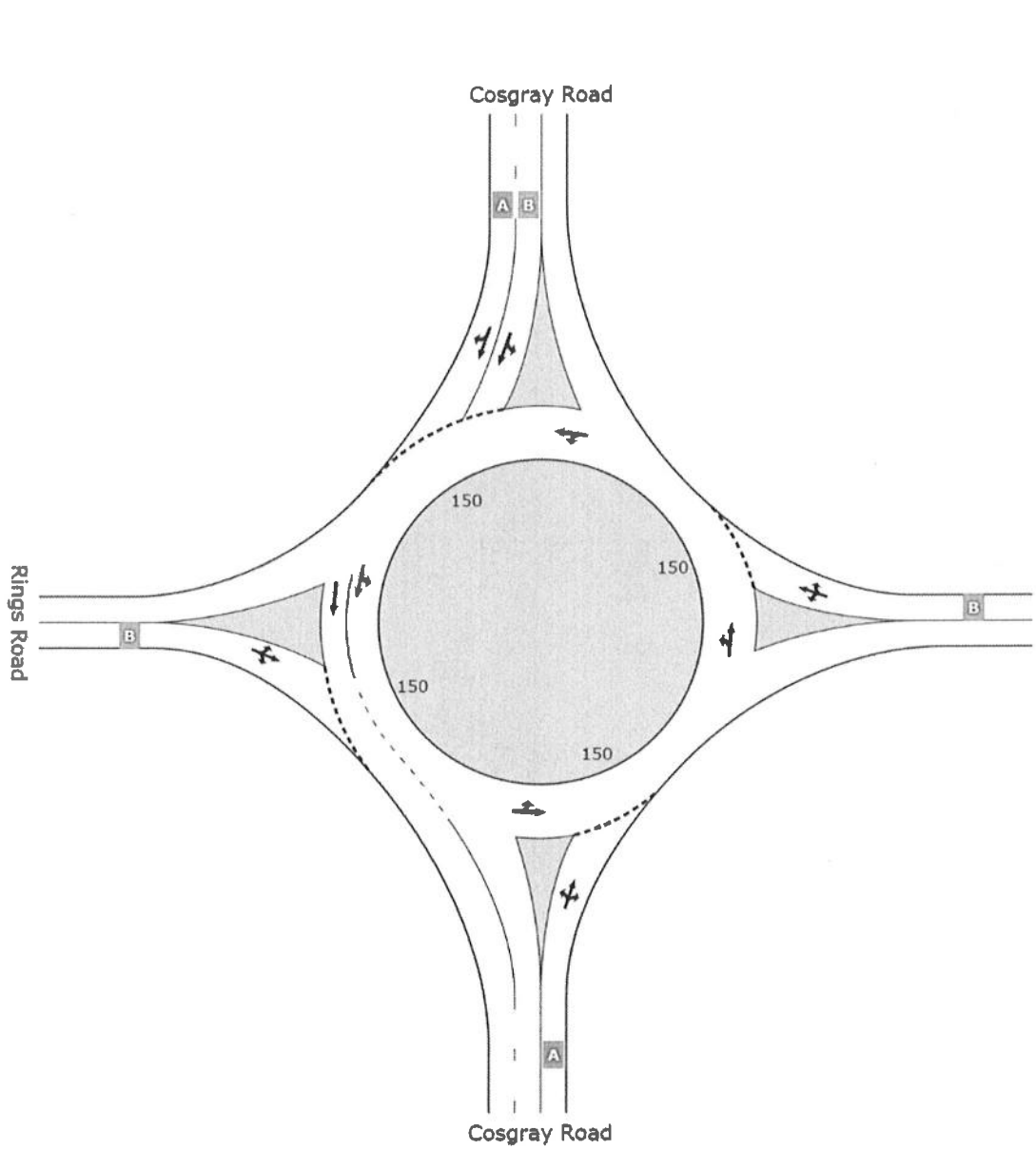
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 PM No Build 2

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 PM No Build
Roundabout



	South	East	North	West	Intersection
LOS	A	B	B	B	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 PM Build 1

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 PM Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	120	3.0	0.391	12.4	LOS B	3.1	78.4	0.26	0.87	31.6
8	T	337	3.0	0.391	5.3	LOS A	3.1	78.4	0.26	0.37	36.9
18	R	76	3.0	0.391	6.2	LOS A	3.1	78.4	0.26	0.47	35.8
Approach		533	3.0	0.391	7.0	LOS A	3.1	78.4	0.26	0.50	35.4
East:											
1	L	323	3.0	0.584	16.3	LOS B	5.2	132.3	0.80	1.00	22.1
6	T	104	3.0	0.584	6.9	LOS A	5.2	132.3	0.80	0.85	22.0
16	R	37	3.0	0.584	8.7	LOS A	5.2	132.3	0.80	0.89	23.1
Approach		464	3.0	0.584	13.6	LOS B	5.2	132.3	0.80	0.96	22.1
North: Cosgray Road											
7	L	16	3.0	1.220	128.6	LOS F	70.2	1795.9	1.00	2.77	8.6
4	T	796	3.0	1.220	123.1	LOS F	70.2	1795.9	1.00	2.77	9.3
14	R	59	3.0	1.220	123.8	LOS F	70.2	1795.9	1.00	2.77	8.6
Approach		871	3.0	1.220	123.2	LOS F	70.2	1795.9	1.00	2.77	9.3
West: Rings Road											
5	L	21	3.0	0.214	22.1	LOS C	1.4	36.3	0.92	0.96	25.0
2	T	13	3.0	0.214	11.9	LOS B	1.4	36.3	0.92	0.90	25.2
12	R	49	3.0	0.214	14.6	LOS B	1.4	36.3	0.92	0.92	26.5
Approach		83	3.0	0.214	16.1	LOS B	1.4	36.3	0.92	0.93	25.9
All Vehicles		1950	3.0	1.220	60.9	LOS E	70.2	1795.9	0.75	1.64	14.7

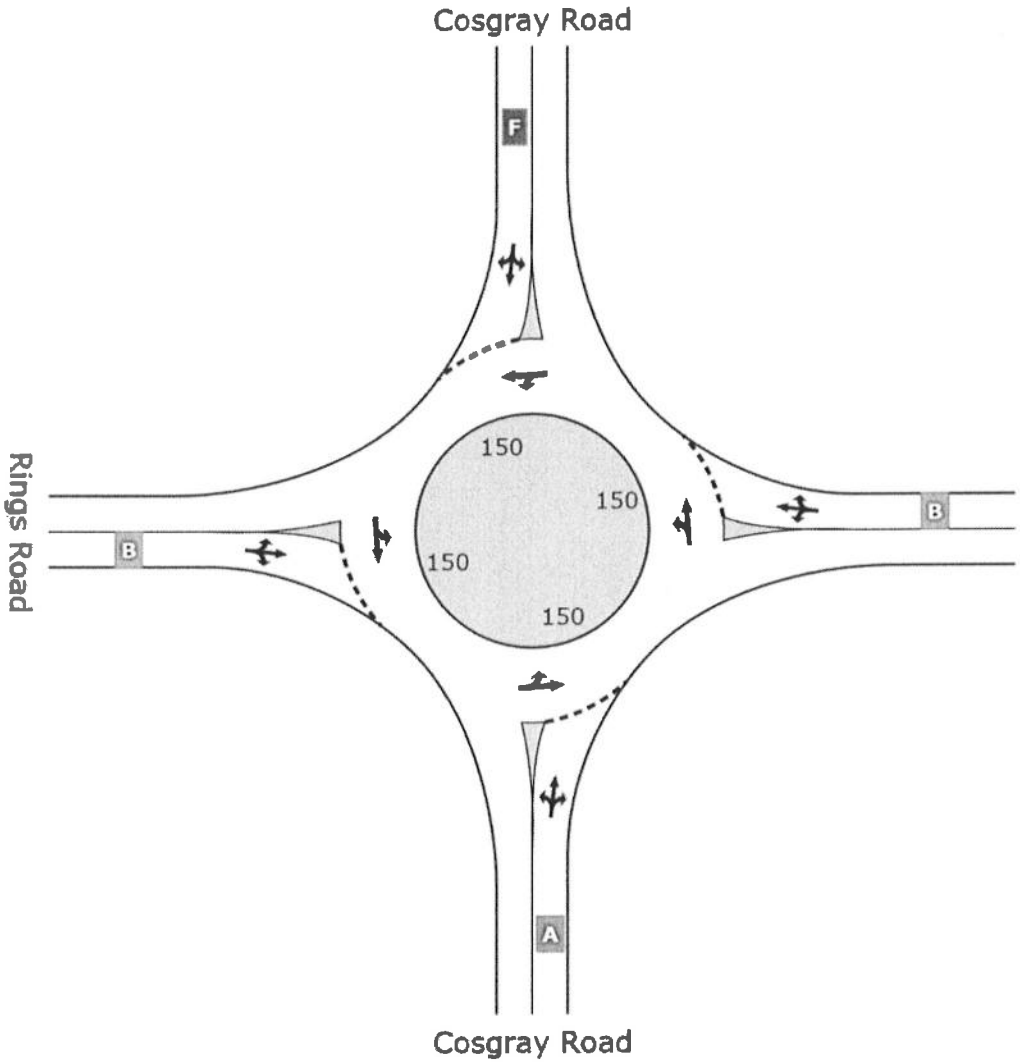
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 PM Build 1

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 PM Build
Roundabout



	South	East	North	West	Intersection
LOS	A	B	F	B	E

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 PM Build 2

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 PM Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Cosgray Road											
3	L	120	3.0	0.393	12.5	LOS B	3.0	76.0	0.26	0.87	31.6
8	T	337	3.0	0.393	5.3	LOS A	3.0	76.0	0.26	0.37	36.9
18	R	76	3.0	0.393	6.2	LOS A	3.0	76.0	0.26	0.47	35.8
Approach		533	3.0	0.393	7.1	LOS A	3.0	76.0	0.26	0.50	35.4
East:											
1	L	323	3.0	0.584	16.3	LOS B	5.2	132.2	0.80	1.00	22.1
6	T	104	3.0	0.584	6.9	LOS A	5.2	132.2	0.80	0.85	22.0
16	R	37	3.0	0.584	8.7	LOS A	5.2	132.2	0.80	0.89	23.1
Approach		464	3.0	0.584	13.6	LOS B	5.2	132.2	0.80	0.96	22.2
North: Cosgray Road											
7	L	16	3.0	0.519	16.0	LOS B	4.3	111.0	0.84	0.99	29.4
4	T	796	3.0	0.519	10.2	LOS B	4.5	115.3	0.83	0.84	33.2
14	R	59	3.0	0.519	10.4	LOS B	4.5	115.3	0.83	0.86	33.0
Approach		871	3.0	0.519	10.4	LOS B	4.5	115.3	0.83	0.84	33.1
West: Rings Road											
5	L	21	3.0	0.184	18.0	LOS B	0.8	21.3	0.74	0.96	26.6
2	T	13	3.0	0.184	7.8	LOS A	0.8	21.3	0.74	0.80	27.7
12	R	49	3.0	0.184	10.4	LOS B	0.8	21.3	0.74	0.84	28.8
Approach		83	3.0	0.184	11.9	LOS B	0.8	21.3	0.74	0.87	28.0
All Vehicles		1950	3.0	0.584	10.3	LOS B	5.2	132.2	0.66	0.78	29.7

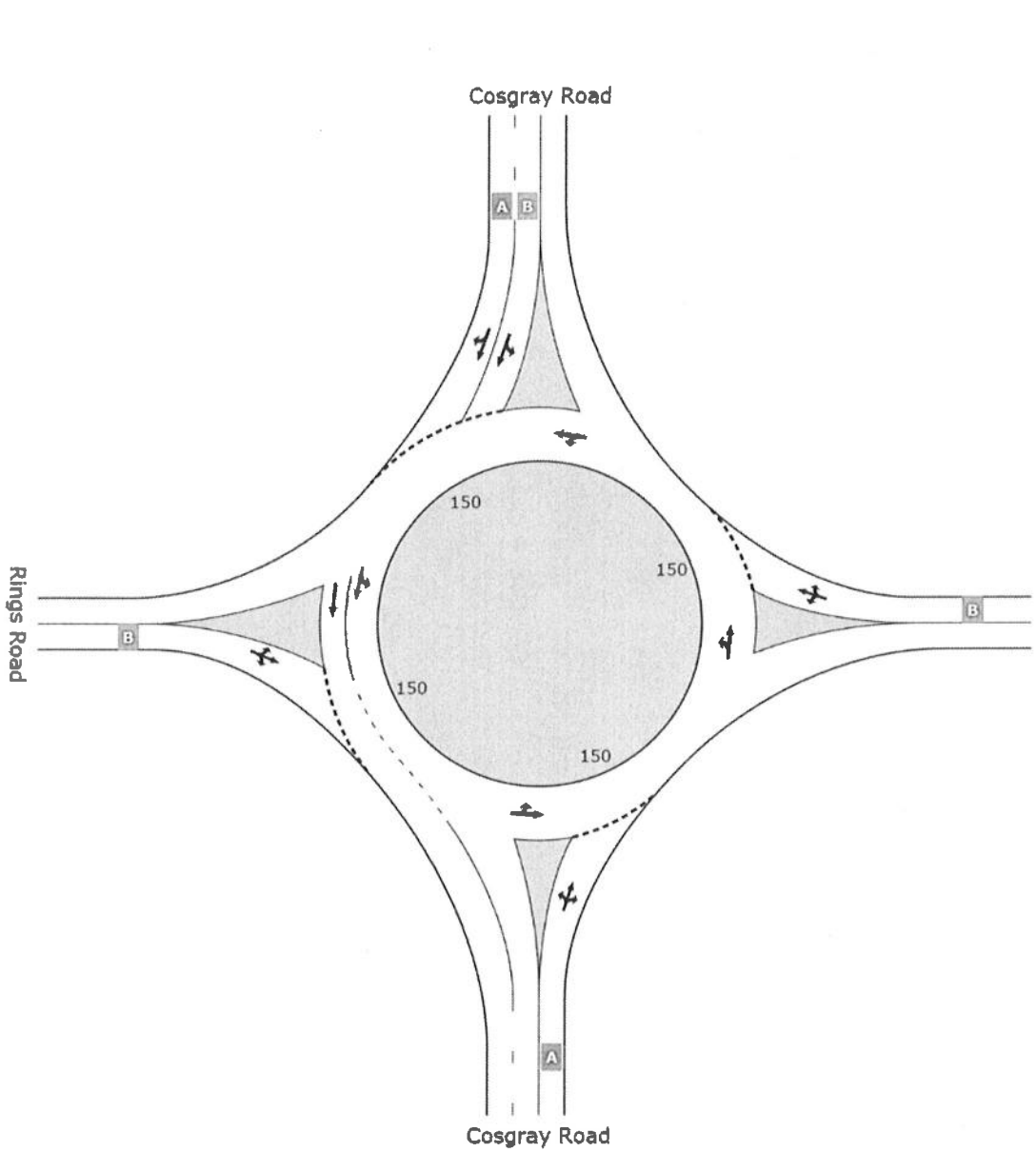
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 PM Build 2

Liggett Tract 2014-1763
Rings Road/Cosgray Road
2025 PM Build
Roundabout



	South	East	North	West	Intersection
LOS	A	B	B	B	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

COSGRAY ROAD/CHURCHMAN ROAD

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	Cosgray/Churchman
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	1/27/2015	Analysis Year	
Analysis Time Period	2015 AM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Churchman Road* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		535	20	6	164	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	581	21	6	178	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				61		17
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	66	0	18
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		6		84				
C (m) (veh/h)		980		386				
v/c		0.01		0.22				
95% queue length		0.02		0.82				
Control Delay (s/veh)		8.7		16.9				
LOS		A		C				
Approach Delay (s/veh)	--	--	16.9					
Approach LOS	--	--	C					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 8:56 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	Cosgray/Churchman
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	1/27/2015	Analysis Year	
Analysis Time Period	2015 PM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Churchman Road* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		252	68	19	594	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	273	73	20	645	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				40		11
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	43	0	11
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		20		54				
C (m) (veh/h)		1219		309				
v/c		0.02		0.17				
95% queue length		0.05		0.62				
Control Delay (s/veh)		8.0		19.1				
LOS		A		C				
Approach Delay (s/veh)	--	--	19.1					
Approach LOS	--	--	C					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 8:58 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	Cosgray/Churchman
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	1/27/2015	Analysis Year	
Analysis Time Period	2025 AM, Background Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Churchman Road* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		712	1	3	218	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	773	1	3	236	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				20		39
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	21	0	42
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		3		63				
C (m) (veh/h)		846		341				
v/c		0.00		0.18				
95% queue length		0.01		0.67				
Control Delay (s/veh)		9.3		17.9				
LOS		A		C				
Approach Delay (s/veh)	--	--	17.9					
Approach LOS	--	--	C					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 9:29 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	Cosgray/Churchman
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	1/27/2015	Analysis Year	
Analysis Time Period	2025 PM, Background Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Churchman Road* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		335	14	28	790	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	364	15	30	858	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				3		7
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	3	0	7
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		30		10				
C (m) (veh/h)		1185		365				
v/c		0.03		0.03				
95% queue length		0.08		0.08				
Control Delay (s/veh)		8.1		15.1				
LOS		A		C				
Approach Delay (s/veh)	--	--	15.1					
Approach LOS	--	--	C					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 9:27 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	Cosgray/Churchman
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	1/27/2015	Analysis Year	
Analysis Time Period	2025 AM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Churchman Road* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		713	4	7	218	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	774	4	7	236	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				28		52
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	30	0	56
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		7		86				
C (m) (veh/h)		843		336				
v/c		0.01		0.26				
95% queue length		0.03		1.00				
Control Delay (s/veh)		9.3		19.4				
LOS		A		C				
Approach Delay (s/veh)	--	--	19.4					
Approach LOS	--	--	C					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 9:19 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	Cosgray/Churchman
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	1/27/2015	Analysis Year	
Analysis Time Period	2025 PM, Total Traffic		

Project Description *Ballantrae Woods, 2014-1763*

East/West Street: *Churchman Road* | North/South Street: *Cosgray Road*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		339	23	43	790	
Peak-Hour Factor, PHF	1.00	0.92	0.92	0.92	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	0	368	24	46	858	0
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				8		16
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	8	0	17
Percent Heavy Vehicles	0	0	0	1	0	1
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		46		25				
C (m) (veh/h)		1172		337				
v/c		0.04		0.07				
95% queue length		0.12		0.24				
Control Delay (s/veh)		8.2		16.5				
LOS		A		C				
Approach Delay (s/veh)	--	--	16.5					
Approach LOS	--	--	C					

Copyright © 2007 University of Florida, All Rights Reserved

HCS+™ Version 5.3

Generated: 4/28/2015 9:20 AM

CHURCHMAN ROAD/Drive A

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	Churchman Rd/Dr A
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	2/4/2015	Analysis Year	
Analysis Time Period	2025 AM, Full Build		

Project Description *Liggett Tract, 2014-1763*

East/West Street: *Dr A*	North/South Street: *Churchman Rd*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	4	79			10	2
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	4	85	0	0	10	2
Percent Heavy Vehicles	1	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	2		12			
Peak-Hour Factor, PHF	0.92	1.00	0.92	1.00	1.00	1.00
Hourly Flow Rate, HFR (veh/h)	2	0	13	0	0	0
Percent Heavy Vehicles	1	0	1	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	4						15	
C (m) (veh/h)	1613						1045	
v/c	0.00						0.01	
95% queue length	0.01						0.04	
Control Delay (s/veh)	7.2						8.5	
LOS	A						A	
Approach Delay (s/veh)	--	--				8.5		
Approach LOS	--	--				A		

Copyright © 2010 University of Florida, All Rights Reserved

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	Churchman Rd/Dr A
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	2/4/2015	Analysis Year	
Analysis Time Period	2025 PM, Full Build		

Project Description *Liggett Tract, 2014-1763*

East/West Street: *Dr A* | North/South Street: *Churchman Rd*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	13	23			61	5
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	1.00
Hourly Flow Rate, HFR (veh/h)	14	24	0	0	66	5
Percent Heavy Vehicles	1	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	1		8			
Peak-Hour Factor, PHF	0.92	1.00	0.92	1.00	1.00	1.00
Hourly Flow Rate, HFR (veh/h)	1	0	8	0	0	0
Percent Heavy Vehicles	1	0	1	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	14						9	
C (m) (veh/h)	1536						982	
v/c	0.01						0.01	
95% queue length	0.03						0.03	
Control Delay (s/veh)	7.4						8.7	
LOS	A						A	
Approach Delay (s/veh)	--	--				8.7		
Approach LOS	--	--				A		

Copyright © 2010 University of Florida, All Rights Reserved

CHURCHMAN ROAD/Drive B/Marmion Drive

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	2/4/2015	Analysis Year	
Analysis Time Period	2025 AM, Full Build		

Project Description *Liggett Tract, 2014-1763*

East/West Street: *Dr B/Marmion Dr* | North/South Street: *Churchman Rd*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	8	43	159	2	17	3
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	8	46	172	2	18	3
Percent Heavy Vehicles	1	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	11		24	13		30
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	11	0	26	14	0	32
Percent Heavy Vehicles	1	0	1	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR			LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LR			LR	
v (veh/h)	8	2		46			37	
C (m) (veh/h)	1601	1358		863			942	
v/c	0.00	0.00		0.05			0.04	
95% queue length	0.02	0.00		0.17			0.12	
Control Delay (s/veh)	7.3	7.7		9.4			9.0	
LOS	A	A		A			A	
Approach Delay (s/veh)	--	--	9.4			9.0		
Approach LOS	--	--	A			A		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 2/5/2015 9:23 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	2/4/2015	Analysis Year	
Analysis Time Period	2025 PM, Full Build		

Project Description *Liggett Tract, 2014-1763*

East/West Street: *Dr B/Marmion Dr* | North/South Street: *Churchman Rd*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	26	24	27	25	34	10
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	28	26	29	27	36	10
Percent Heavy Vehicles	1	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	7		16	141		5
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	7	0	17	153	0	5
Percent Heavy Vehicles	1	0	1	1	0	1
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR			LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LR			LR	
v (veh/h)	28	27		158			24	
C (m) (veh/h)	1568	1556		735			927	
v/c	0.02	0.02		0.21			0.03	
95% queue length	0.05	0.05		0.81			0.08	
Control Delay (s/veh)	7.3	7.4		11.2			9.0	
LOS	A	A		B			A	
Approach Delay (s/veh)	--	--	11.2			9.0		
Approach LOS	--	--	B			A		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 2/5/2015 9:23 AM

CHURCHMAN ROAD/Drive C/Montridge Lane

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	2/4/2015	Analysis Year	
Analysis Time Period	2025 AM, Full Build		

Project Description *Liggett Tract, 2014-1763*

East/West Street: *Dr C/Montridge Ln* | North/South Street: *Churchman Rd*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	8	171	239	2	49	3
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	8	185	259	2	53	3
Percent Heavy Vehicles	1	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	9		24	14		30
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	9	0	26	15	0	32
Percent Heavy Vehicles	1	0	1	1	0	1
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR			LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LR			LR	
v (veh/h)	8	2		47			35	
C (m) (veh/h)	1555	1121		657			823	
v/c	0.01	0.00		0.07			0.04	
95% queue length	0.02	0.01		0.23			0.13	
Control Delay (s/veh)	7.3	8.2		10.9			9.6	
LOS	A	A		B			A	
Approach Delay (s/veh)	--	--	10.9			9.6		
Approach LOS	--	--	B			A		

Copyright © 2010 University of Florida, All Rights Reserved

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	2/4/2015	Analysis Year	
Analysis Time Period	2025 PM, Full Build		

Project Description *Liggett Tract, 2014-1763*

East/West Street: *Dr C/Montridge Ln* | North/South Street: *Churchman Rd*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	26	67	41	17	164	9
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	28	72	44	18	178	9
Percent Heavy Vehicles	1	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	6		16	142		5
Peak-Hour Factor, PHF	0.92	1.00	0.92	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	6	0	17	154	0	5
Percent Heavy Vehicles	1	0	1	1	0	1
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR			LR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LR			LR	
v (veh/h)	28	18		159			23	
C (m) (veh/h)	1393	1479		563			760	
v/c	0.02	0.01		0.28			0.03	
95% queue length	0.06	0.04		1.15			0.09	
Control Delay (s/veh)	7.6	7.5		13.9			9.9	
LOS	A	A		B			A	
Approach Delay (s/veh)	--	--	13.9			9.9		
Approach LOS	--	--	B			A		

Copyright © 2010 University of Florida, All Rights Reserved

RINGS ROAD/CHURCHMAN ROAD

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	2/4/2015	Analysis Year	
Analysis Time Period	2015 AM, Full build		

Project Description *Liggett Tract, 2014-1763*

East/West Street: *Rings Rd* | North/South Street: *Churchman Rd*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	1	291			80	3
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	1	316	0	0	86	3
Percent Heavy Vehicles	1	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				9		4
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	9	0	4
Percent Heavy Vehicles	1	0	0	1	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	1						13	
C (m) (veh/h)	1513						683	
v/c	0.00						0.02	
95% queue length	0.00						0.06	
Control Delay (s/veh)	7.4						10.4	
LOS	A						B	
Approach Delay (s/veh)	--	--				10.4		
Approach LOS	--	--				B		

Copyright © 2010 University of Florida, All Rights Reserved

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	City of Dublin
Date Performed	2/4/2015	Analysis Year	
Analysis Time Period	2015 PM, Full build		

Project Description *Liggett Tract, 2014-1763*

East/West Street: *Rings Rd* | North/South Street: *Churchman Rd*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	3	88			326	5
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	3	95	0	0	354	5
Percent Heavy Vehicles	1	--	--	1	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				3		2
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	3	0	2
Percent Heavy Vehicles	1	0	0	1	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT						LR	
v (veh/h)	3						5	
C (m) (veh/h)	1205						608	
v/c	0.00						0.01	
95% queue length	0.01						0.02	
Control Delay (s/veh)	8.0						11.0	
LOS	A						B	
Approach Delay (s/veh)	--	--				11.0		
Approach LOS	--	--				B		

Copyright © 2010 University of Florida, All Rights Reserved

MOVEMENT SUMMARY

Site: 2025 AM No Build

Liggett Tract
Rings Road & Churchman Road
2025 AM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
East: Rings Road											
6	T	127	3.0	0.377	3.0	LOS A	2.5	64.3	0.32	0.31	30.9
16	R	346	3.0	0.377	3.5	LOS A	2.5	64.3	0.32	0.37	30.4
Approach		473	3.0	0.377	3.3	LOS A	2.5	64.3	0.32	0.36	30.5
North: Churchman Road											
7	L	24	3.0	0.026	8.9	LOS A	0.1	3.2	0.29	0.59	22.8
14	R	5	3.0	0.026	2.3	LOS A	0.1	3.2	0.29	0.25	24.1
Approach		29	3.0	0.026	7.7	LOS A	0.1	3.2	0.29	0.53	23.0
West: Rings Road											
5	L	87	3.0	0.353	7.6	LOS A	2.4	62.6	0.15	0.95	28.0
2	T	440	3.0	0.353	2.6	LOS A	2.4	62.6	0.15	0.24	32.0
Approach		527	3.0	0.353	3.4	LOS A	2.4	62.6	0.15	0.36	31.2
All Vehicles		1029	3.0	0.377	3.5	LOS A	2.5	64.3	0.23	0.36	30.6

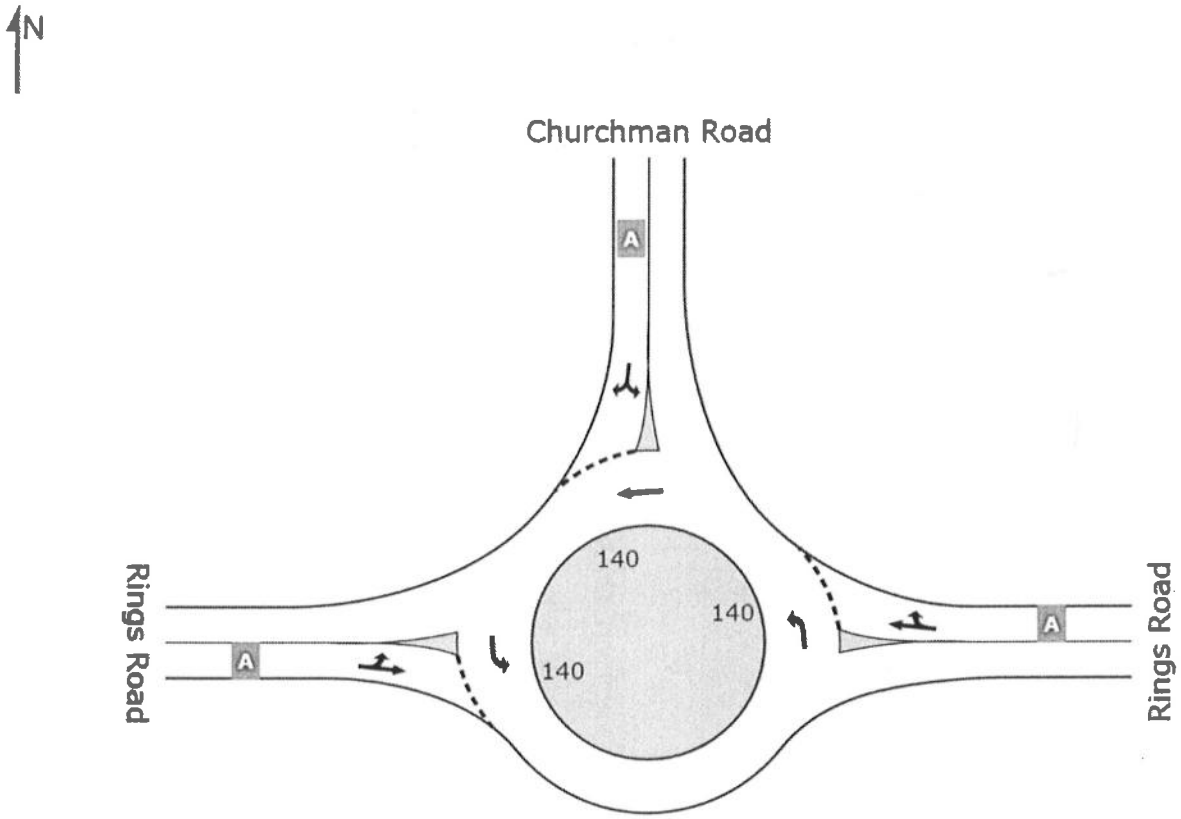
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 AM No Build

Liggett Tract
Rings Road & Churchman Road
2025 AM No Build
Roundabout



	East	North	West	Intersection
LOS	A	A	A	A

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Processed: Thursday, April 30, 2015 8:13:33 AM
SIDRA INTERSECTION 5.1.13.2093

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

Project: J:\20141763\Calculations\Traffic\update based on comments of April 24 2015\Sidra\20141763 Rings and Churchman04-29-2015.sip
8000378, EVANS, MECHWART, HAMBLETON AND TILTON INC, SINGLE

MOVEMENT SUMMARY

Site: 2025 AM Build

Liggett Tract
Rings Road & Churchman Road
2025 AM Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
East: Rings Road											
6	T	129	3.0	0.396	3.0	LOS A	2.8	71.5	0.34	0.32	30.7
16	R	363	3.0	0.396	3.5	LOS A	2.8	71.5	0.34	0.38	30.2
Approach		492	3.0	0.396	3.4	LOS A	2.8	71.5	0.34	0.36	30.4
North: Churchman Road											
7	L	77	3.0	0.084	8.9	LOS A	0.4	11.0	0.31	0.60	22.8
14	R	17	3.0	0.084	2.3	LOS A	0.4	11.0	0.31	0.27	24.0
Approach		95	3.0	0.084	7.7	LOS A	0.4	11.0	0.31	0.54	23.0
West: Rings Road											
5	L	91	3.0	0.406	8.0	LOS A	2.9	75.1	0.31	0.88	28.0
2	T	446	3.0	0.406	3.0	LOS A	2.9	75.1	0.31	0.31	31.0
Approach		537	3.0	0.406	3.8	LOS A	2.9	75.1	0.31	0.40	30.4
All Vehicles		1124	3.0	0.406	4.0	LOS A	2.9	75.1	0.33	0.40	29.5

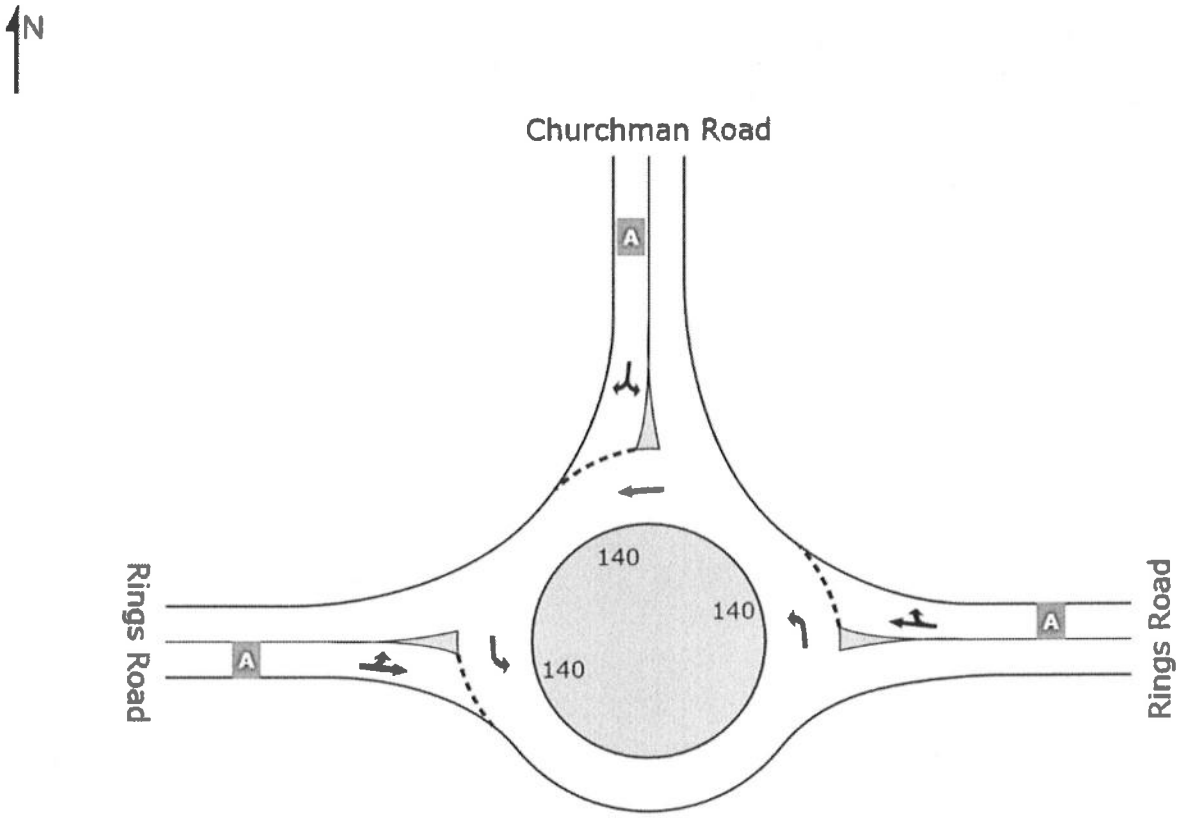
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 AM Build

Liggett Tract
Rings Road & Churchman Road
2025 AM Build
Roundabout



	East	North	West	Intersection
LOS	A	A	A	A

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 PM No Build

Liggett Tract
Rings Road & Churchman Road
2025 PM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
East: Rings Road											
6	T	403	3.0	0.308	2.4	LOS A	2.1	54.3	0.11	0.24	32.3
16	R	59	3.0	0.308	2.9	LOS A	2.1	54.3	0.11	0.32	31.3
Approach		462	3.0	0.308	2.5	LOS A	2.1	54.3	0.11	0.25	32.2
North: Churchman Road											
7	L	246	3.0	0.341	11.2	LOS B	2.0	52.2	0.61	0.76	22.3
14	R	62	3.0	0.341	4.6	LOS A	2.0	52.2	0.61	0.57	23.0
Approach		308	3.0	0.341	9.9	LOS A	2.0	52.2	0.61	0.72	22.4
West: Rings Road											
5	L	15	3.0	0.110	8.9	LOS A	0.6	15.5	0.46	0.88	27.9
2	T	95	3.0	0.110	3.8	LOS A	0.6	15.5	0.46	0.40	30.2
Approach		110	3.0	0.110	4.5	LOS A	0.6	15.5	0.46	0.46	29.9
All Vehicles		879	3.0	0.341	5.3	LOS A	2.1	54.3	0.33	0.44	27.5

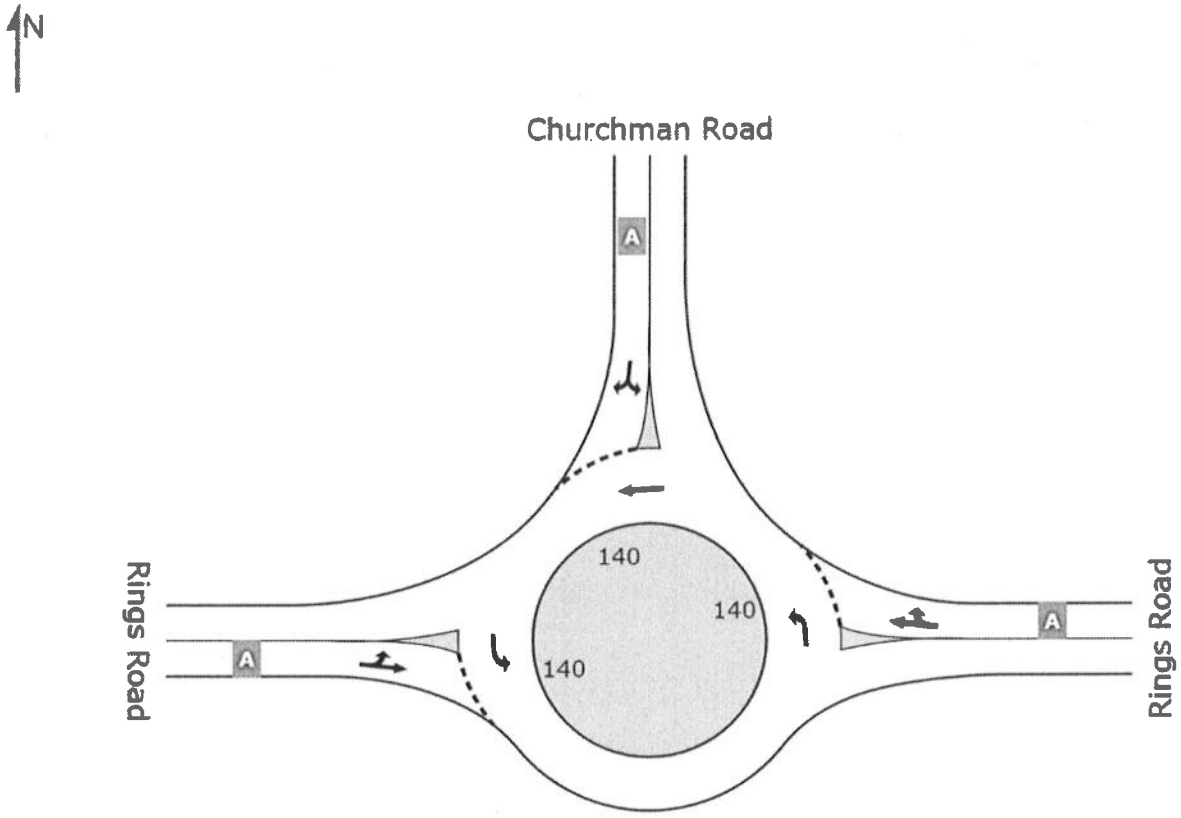
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 PM No Build

Liggett Tract
Rings Road & Churchman Road
2025 PM No Build
Roundabout



	East	North	West	Intersection
LOS	A	A	A	A

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Processed: Thursday, April 30, 2015 8:13:34 AM
SIDRA INTERSECTION 5.1.13.2093

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

Project: J:\20141763\Calculations\Traffic\update based on comments of April 24 2015\Sidra\20141763 Rings and Churchman04-29-2015.sip
8000378, EVANS, MECHWART, HAMBLETON AND TILTON INC, SINGLE

MOVEMENT SUMMARY

Site: 2025 PM Build

Liggett Tract
Rings Road & Churchman Road
2025 PM Build
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
East: Rings Road											
6	T	409	3.0	0.366	2.5	LOS A	2.7	69.4	0.18	0.25	31.9
16	R	117	3.0	0.366	3.0	LOS A	2.7	69.4	0.18	0.32	31.0
Approach		526	3.0	0.366	2.6	LOS A	2.7	69.4	0.18	0.26	31.7
North: Churchman Road											
7	L	280	3.0	0.392	11.4	LOS B	2.5	63.2	0.65	0.78	22.2
14	R	70	3.0	0.392	4.8	LOS A	2.5	63.2	0.65	0.60	22.9
Approach		350	3.0	0.392	10.1	LOS B	2.5	63.2	0.65	0.74	22.3
West: Rings Road											
5	L	28	3.0	0.131	9.1	LOS A	0.7	18.9	0.50	0.86	27.8
2	T	98	3.0	0.131	4.1	LOS A	0.7	18.9	0.50	0.43	29.9
Approach		126	3.0	0.131	5.2	LOS A	0.7	18.9	0.50	0.52	29.4
All Vehicles		1002	3.0	0.392	5.6	LOS A	2.7	69.4	0.38	0.46	27.2

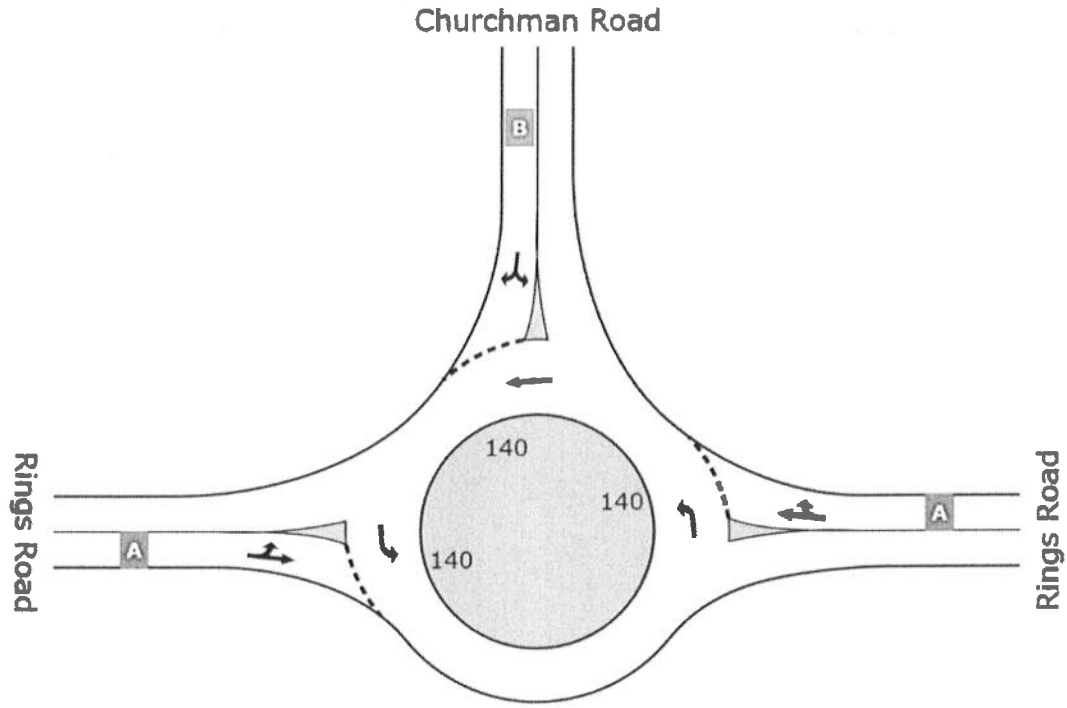
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 PM Build

Liggett Tract
Rings Road & Churchman Road
2025 PM Build
Roundabout



	East	North	West	Intersection
LOS	A	B	A	A

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

RINGS ROAD/EITERMAN ROAD

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2015 AM Peak, Background		

Project Description 2014-1763, Ballantrae Woods

East/West Street: Rings Road | North/South Street: Eiterman Road

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	99	205			69	29
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	107	222	0	0	74	31
Percent Heavy Vehicles	3	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				34		19
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	36	0	20
Percent Heavy Vehicles	0	0	0	3	0	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
v (veh/h)	107					36		20
C (m) (veh/h)	1480					473		965
v/c	0.07					0.08		0.02
95% queue length	0.23					0.25		0.06
Control Delay (s/veh)	7.6					13.2		8.8
LOS	A					B		A
Approach Delay (s/veh)	--	--				11.7		
Approach LOS	--	--				B		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 4/30/2015 10:21 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2015 AM Peak, Build		

Project Description 2014-1763, Ballantrae Woods

East/West Street: Rings Road | North/South Street: Eiterman Road

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	99	256			86	29
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	107	278	0	0	93	31
Percent Heavy Vehicles	3	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				34		19
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	36	0	20
Percent Heavy Vehicles	0	0	0	3	0	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
v (veh/h)	107					36		20
C (m) (veh/h)	1457					428		943
v/c	0.07					0.08		0.02
95% queue length	0.24					0.27		0.06
Control Delay (s/veh)	7.7					14.2		8.9
LOS	A					B		A
Approach Delay (s/veh)	--	--				12.3		
Approach LOS	--	--				B		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 4/30/2015 10:21 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2025 AM Peak, Background		

Project Description *2014-1763, Ballantrae Woods*

East/West Street: *Rings Road* | North/South Street: *Eiterman Road*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	132	295			410	39
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	143	320	0	0	445	42
Percent Heavy Vehicles	3	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				45		25
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	48	0	27
Percent Heavy Vehicles	0	0	0	3	0	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	143					48		27
C (m) (veh/h)	1071					211		595
v/c	0.13					0.23		0.05
95% queue length	0.46					0.85		0.14
Control Delay (s/veh)	8.9					27.0		11.3
LOS	A					D		B
Approach Delay (s/veh)	--	--				21.4		
Approach LOS	--	--				C		

Copyright © 2010 University of Florida, All Rights Reserved

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2025 AM Peak, Build		

Project Description 2014-1763, Ballantrae Woods

East/West Street: Rings Road | North/South Street: Eiterman Road

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	132	346			427	39
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	143	376	0	0	464	42
Percent Heavy Vehicles	3	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				45		25
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	48	0	27
Percent Heavy Vehicles	0	0	0	3	0	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	143					48		27
C (m) (veh/h)	1054					189		580
v/c	0.14					0.25		0.05
95% queue length	0.47					0.97		0.15
Control Delay (s/veh)	9.0					30.4		11.5
LOS	A					D		B
Approach Delay (s/veh)	--	--				23.6		
Approach LOS	--	--				C		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 4/30/2015 9:16 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2015 PM Peak, Background		

Project Description 2014-1763, Ballantrae Woods

East/West Street: Rings Road	North/South Street: Eiterman Road
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	23	42			227	37
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	24	45	0	0	246	40
Percent Heavy Vehicles	3	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				29		52
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	31	0	56
Percent Heavy Vehicles	0	0	0	3	0	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
v (veh/h)	24					31		56
C (m) (veh/h)	1270					626		770
v/c	0.02					0.05		0.07
95% queue length	0.06					0.16		0.23
Control Delay (s/veh)	7.9					11.1		10.0
LOS	A					B		B
Approach Delay (s/veh)	--	--				10.4		
Approach LOS	--	--				B		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 4/30/2015 10:22 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2015 PM Peak, Build		

Project Description 2014-1763, Ballantrae Woods

East/West Street: Rings Road | North/South Street: Eiterman Road

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	23	76			284	37
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	24	82	0	0	308	40
Percent Heavy Vehicles	3	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT					TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				29		52
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	31	0	56
Percent Heavy Vehicles	0	0	0	3	0	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
v (veh/h)	24					31		56
C (m) (veh/h)	1205					548		711
v/c	0.02					0.06		0.08
95% queue length	0.06					0.18		0.26
Control Delay (s/veh)	8.0					12.0		10.5
LOS	A					B		B
Approach Delay (s/veh)	--	--				11.0		
Approach LOS	--	--				B		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 4/30/2015 10:22 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2025 PM Peak, Background		

Project Description 2014-1763, Ballantrae Woods

East/West Street: Rings Road	North/South Street: Eiterman Road
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	31	282			356	49
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	33	306	0	0	386	53
Percent Heavy Vehicles	3	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				39		69
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	42	0	74
Percent Heavy Vehicles	0	0	0	3	0	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	33					42		74
C (m) (veh/h)	1116					350		638
v/c	0.03					0.12		0.12
95% queue length	0.09					0.40		0.39
Control Delay (s/veh)	8.3					16.7		11.4
LOS	A					C		B
Approach Delay (s/veh)	--	--				13.3		
Approach LOS	--	--				B		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 4/30/2015 1:05 PM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2025 PM Peak, Build		

Project Description 2014-1763, Ballantrae Woods

East/West Street: Rings Road | North/South Street: Eiterman Road

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	31	316			413	49
Peak-Hour Factor, PHF	0.92	0.92	1.00	1.00	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	33	343	0	0	448	53
Percent Heavy Vehicles	3	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	1	0	0	1	0
Configuration	L	T				TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				39		69
Peak-Hour Factor, PHF	1.00	1.00	1.00	0.92	1.00	0.92
Hourly Flow Rate, HFR (veh/h)	0	0	0	42	0	74
Percent Heavy Vehicles	0	0	0	3	0	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	33					42		74
C (m) (veh/h)	1058					305		588
v/c	0.03					0.14		0.13
95% queue length	0.10					0.47		0.43
Control Delay (s/veh)	8.5					18.7		12.0
LOS	A					C		B
Approach Delay (s/veh)	--	--				14.4		
Approach LOS	--	--				B		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 4/30/2015 9:19 AM

RINGS ROAD/CARA ROAD/ AVERY ROAD

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2015 AM Peak, Background		

Project Description 2014-1763, Ballantrae Woods

East/West Street: Rings Road | North/South Street: Avery Road

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	32	605	3	2	330	39
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	34	657	3	2	358	42
Percent Heavy Vehicles	3	--	--	3	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	154	0	69	2	1	5
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	167	0	74	2	1	5
Percent Heavy Vehicles	3	3	3	3	3	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR			LTR	
v (veh/h)	34	2		8			241	
C (m) (veh/h)	1153	923		273			226	
v/c	0.03	0.00		0.03			1.07	
95% queue length	0.09	0.01		0.09			10.49	
Control Delay (s/veh)	8.2	8.9		18.6			124.6	
LOS	A	A		C			F	
Approach Delay (s/veh)	--	--	18.6			124.6		
Approach LOS	--	--	C			F		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 4/30/2015 9:34 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	154	0	69	2	1	5	32	605	3	2	330	39
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	167	0	75	2	1	5	35	658	3	2	359	42
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	290	6	90	122	75	210	91	1192	5	58	1105	129
Arrive On Green	0.20	0.00	0.20	0.20	0.20	0.20	0.68	0.68	0.68	0.68	0.68	0.68
Sat Flow, veh/h	979	30	453	257	378	1058	46	1765	8	1	1636	190
Grp Volume(v), veh/h	242	0	0	8	0	0	696	0	0	403	0	0
Grp Sat Flow(s),veh/h/ln	1463	0	0	1692	0	0	1820	0	0	1827	0	0
Q Serve(g_s), s	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	10.1	0.0	0.0	0.2	0.0	0.0	12.3	0.0	0.0	5.8	0.0	0.0
Prop In Lane	0.69		0.31	0.25		0.62	0.05		0.00	0.00		0.10
Lane Grp Cap(c), veh/h	387	0	0	407	0	0	1288	0	0	1291	0	0
V/C Ratio(X)	0.63	0.00	0.00	0.02	0.00	0.00	0.54	0.00	0.00	0.31	0.00	0.00
Avail Cap(c_a), veh/h	531	0	0	560	0	0	1288	0	0	1291	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	24.4	0.0	0.0	20.5	0.0	0.0	5.4	0.0	0.0	4.3	0.0	0.0
Incr Delay (d2), s/veh	1.7	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.2	0.0	0.0	0.1	0.0	0.0	6.8	0.0	0.0	3.1	0.0	0.0
LnGrp Delay(d),s/veh	26.1	0.0	0.0	20.5	0.0	0.0	7.0	0.0	0.0	4.9	0.0	0.0
LnGrp LOS	C			C			A			A		
Approach Vol, veh/h		242			8			696			403	
Approach Delay, s/veh		26.1			20.5			7.0			4.9	
Approach LOS		C			C			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		47.0		16.7		47.0		16.7
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		43.0		19.0		43.0		19.0
Max Q Clear Time (g_c+I1), s		14.3		12.1		7.8		2.2
Green Ext Time (p_c), s		8.9		0.7		9.5		1.2

Intersection Summary	
HCM 2010 Ctrl Delay	9.9
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	191	0	85	2	1	5	37	605	3	2	330	51
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	208	0	92	2	1	5	40	658	3	2	359	55
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	338	4	109	137	86	254	95	1103	5	58	995	152
Arrive On Green	0.24	0.00	0.24	0.24	0.24	0.24	0.63	0.63	0.63	0.63	0.63	0.63
Sat Flow, veh/h	996	16	448	273	355	1046	55	1747	8	1	1577	240
Grp Volume(v), veh/h	300	0	0	8	0	0	701	0	0	416	0	0
Grp Sat Flow(s),veh/h/ln	1459	0	0	1674	0	0	1810	0	0	1818	0	0
Q Serve(g_s), s	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	12.4	0.0	0.0	0.2	0.0	0.0	14.1	0.0	0.0	6.9	0.0	0.0
Prop In Lane	0.69		0.31	0.25		0.62	0.06		0.00	0.00		0.13
Lane Grp Cap(c), veh/h	450	0	0	477	0	0	1203	0	0	1205	0	0
V/C Ratio(X)	0.67	0.00	0.00	0.02	0.00	0.00	0.58	0.00	0.00	0.35	0.00	0.00
Avail Cap(c_a), veh/h	602	0	0	637	0	0	1203	0	0	1205	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	22.9	0.0	0.0	18.3	0.0	0.0	6.9	0.0	0.0	5.6	0.0	0.0
Incr Delay (d2), s/veh	1.7	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.8	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.2	0.0	0.0	0.1	0.0	0.0	7.7	0.0	0.0	3.7	0.0	0.0
LnGrp Delay(d),s/veh	24.6	0.0	0.0	18.3	0.0	0.0	9.0	0.0	0.0	6.4	0.0	0.0
LnGrp LOS	C			B			A			A		
Approach Vol, veh/h		300			8			701			416	
Approach Delay, s/veh		24.6			18.3			9.0			6.4	
Approach LOS		C			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		44.0		19.4		44.0		19.4
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		40.0		22.0		40.0		22.0
Max Q Clear Time (g_c+I1), s		16.1		14.4		8.9		2.2
Green Ext Time (p_c), s		8.6		1.0		9.4		1.7

Intersection Summary	
HCM 2010 Ctrl Delay	11.6
HCM 2010 LOS	B

MOVEMENT SUMMARY

Site: 2025 AM No Build

Liggett Tract 2014-1763
Rings Road/Cara Road & Avery Road
2025 AM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Avery Road											
3	L	283	3.0	1.145	89.4	LOS F	68.8	1761.9	1.00	2.28	12.0
8	T	1979	3.0	1.145	82.8	LOS F	71.2	1823.5	1.00	2.28	12.5
18	R	24	3.0	1.145	83.0	LOS F	71.2	1823.5	1.00	2.29	11.1
Approach		2286	3.0	1.145	83.6	LOS F	71.2	1823.5	1.00	2.28	12.5
East: Cara Road											
1	L	28	3.0	0.774	58.1	LOS E	4.8	122.9	0.98	1.27	14.0
6	T	15	3.0	0.774	49.2	LOS D	4.8	122.9	0.98	1.25	13.0
16	R	72	3.0	0.774	50.8	LOS D	4.8	122.9	0.98	1.25	13.8
Approach		115	3.0	0.774	52.4	LOS D	4.8	122.9	0.98	1.25	13.7
North: Avery Road											
7	L	8	3.0	0.476	12.5	LOS B	3.3	83.5	0.61	0.90	31.5
4	T	603	3.0	0.476	7.8	LOS A	3.3	83.7	0.61	0.60	34.1
14	R	328	3.0	0.476	8.0	LOS A	3.3	83.7	0.61	0.64	33.1
Approach		939	3.0	0.476	7.9	LOS A	3.3	83.7	0.61	0.62	33.7
West: Rings Road											
5	L	282	3.0	0.405	15.7	LOS B	2.2	57.3	0.68	0.91	27.3
2	T	40	3.0	0.405	5.5	LOS A	2.2	57.3	0.68	0.62	27.5
12	R	102	3.0	0.205	10.0	LOS B	0.9	22.1	0.63	0.80	29.1
Approach		424	3.0	0.405	13.3	LOS B	2.2	57.3	0.67	0.86	27.7
All Vehicles		3764	3.0	1.145	55.9	LOS E	71.2	1823.5	0.86	1.68	16.0

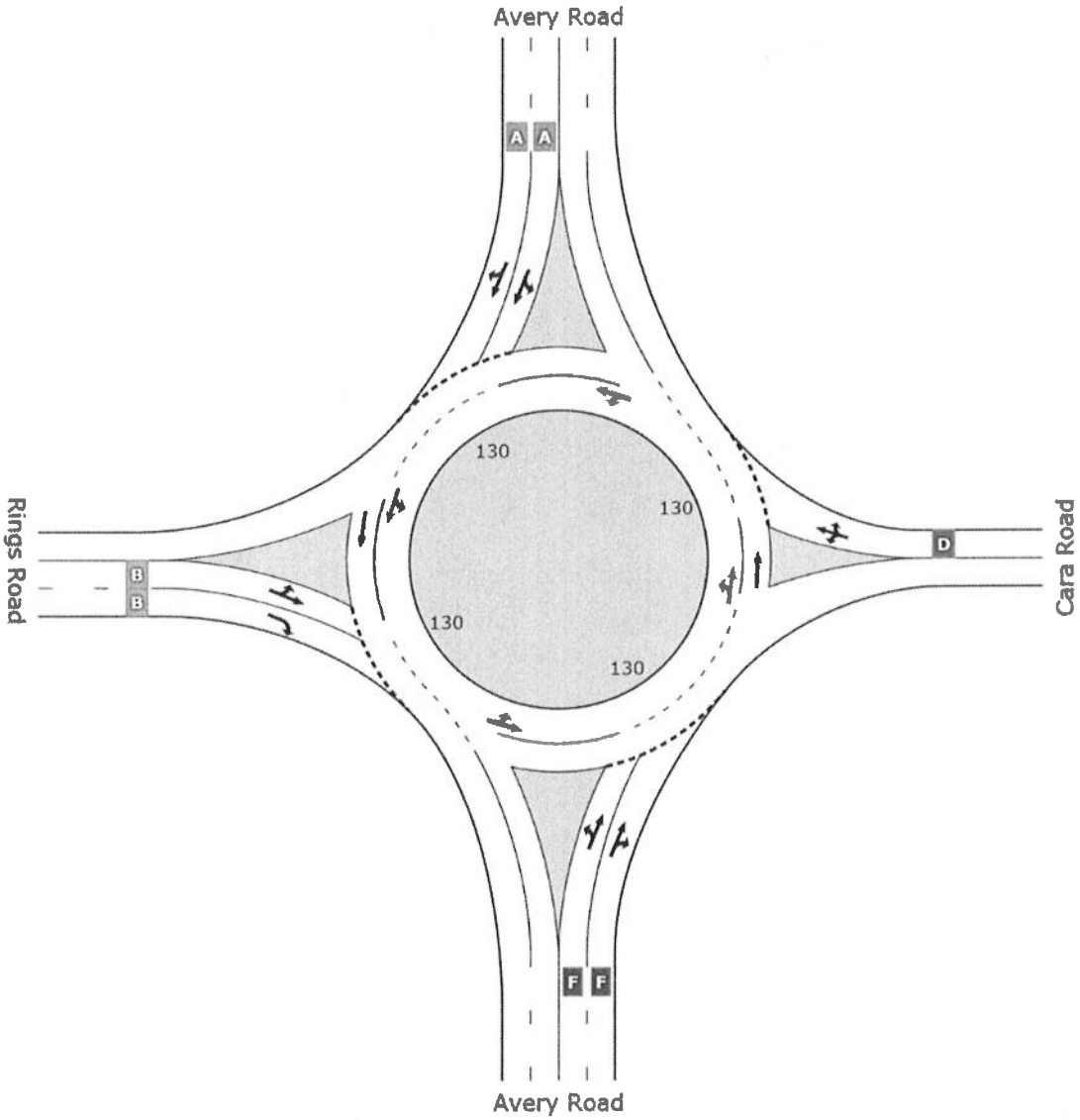
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 AM No Build

Liggett Tract 2014-1763
Rings Road/Cara Road & Avery Road
2025 AM No Build
Roundabout



	South	East	North	West	Intersection
LOS	F	D	A	B	E

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 AM Build

Liggett Tract
Rings Road/Cara Road & Avery Road
2025 AM Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Avery Road											
3	L	288	3.0	1.294	153.1	LOS F	101.2	2591.7	1.00	3.23	7.9
8	T	1979	3.0	1.294	146.9	LOS F	101.3	2593.1	1.00	3.23	8.1
18	R	24	3.0	1.294	147.3	LOS F	101.3	2593.1	1.00	3.23	7.0
Approach		2291	3.0	1.294	147.6	LOS F	101.3	2593.1	1.00	3.23	8.0
East: Cara Road											
1	L	28	3.0	0.645	39.2	LOS D	3.7	94.4	0.95	1.17	16.8
6	T	15	3.0	0.645	30.3	LOS C	3.7	94.4	0.95	1.13	16.0
16	R	72	3.0	0.645	31.9	LOS C	3.7	94.4	0.95	1.14	16.9
Approach		115	3.0	0.645	33.4	LOS C	3.7	94.4	0.95	1.15	16.7
North: Avery Road											
7	L	8	3.0	0.469	12.3	LOS B	3.2	82.0	0.59	0.90	31.5
4	T	603	3.0	0.469	7.6	LOS A	3.2	82.3	0.59	0.58	34.2
14	R	341	3.0	0.469	7.8	LOS A	3.2	82.3	0.58	0.63	33.2
Approach		952	3.0	0.469	7.7	LOS A	3.2	82.3	0.59	0.60	33.8
West: Rings Road											
5	L	322	3.0	0.454	16.1	LOS B	2.7	69.0	0.70	0.94	27.1
2	T	40	3.0	0.454	5.9	LOS A	2.7	69.0	0.70	0.68	27.4
12	R	120	3.0	0.233	10.0	LOS B	1.0	25.7	0.64	0.81	29.2
Approach		482	3.0	0.454	13.7	LOS B	2.7	69.0	0.68	0.88	27.5
All Vehicles		3840	3.0	1.294	92.7	LOS F	101.3	2593.1	0.86	2.22	11.3

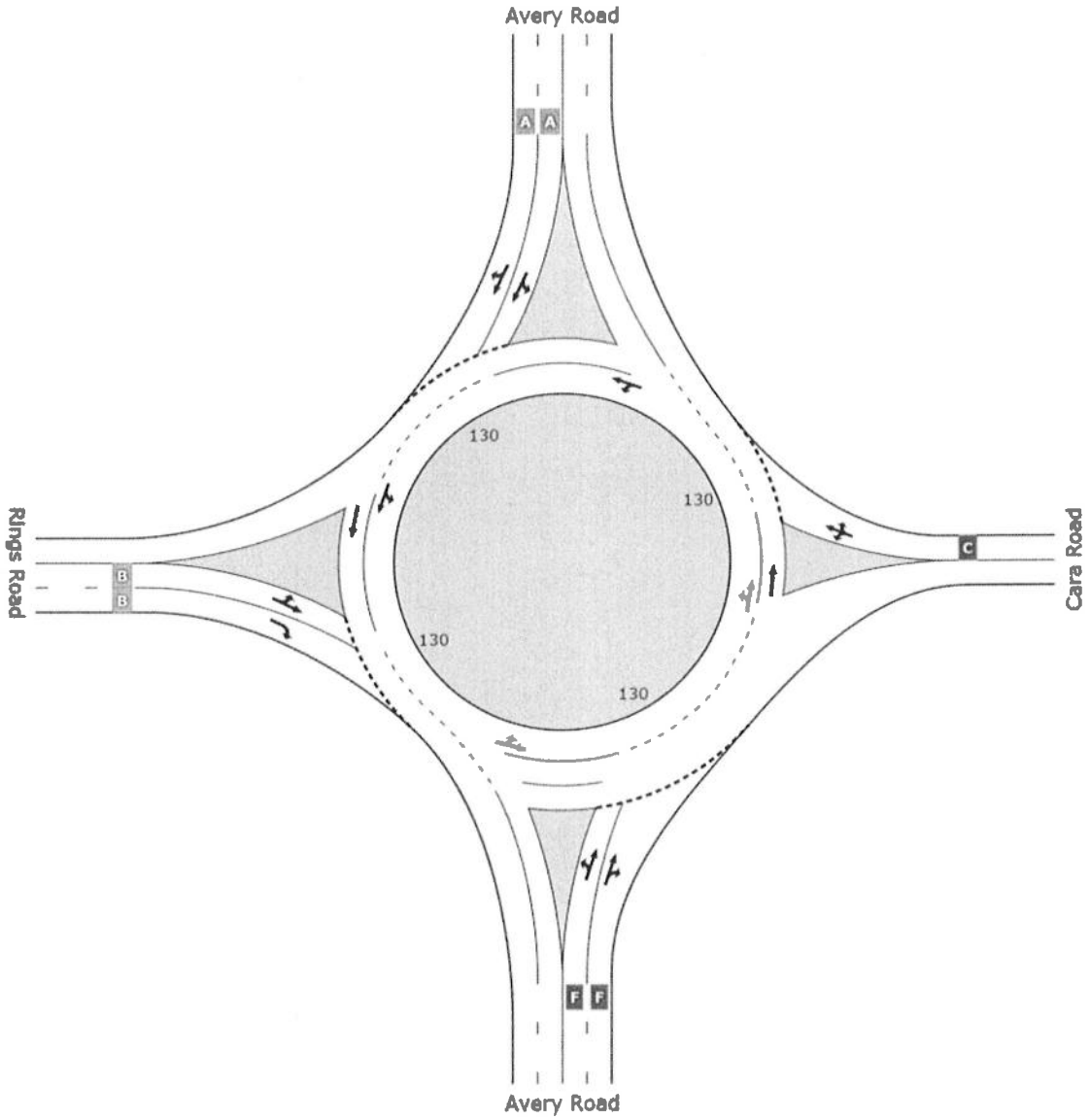
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 AM Build

Liggett Tract
Rings Road/Cara Road & Avery Road
2025 AM Build
Roundabout



	South	East	North	West	Intersection
LOS	F	C	A	B	F

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	CW	Intersection	
Agency/Co.	EMH&T	Jurisdiction	
Date Performed	4/30/2015	Analysis Year	
Analysis Time Period	2015 PM Peak, Background		

Project Description 2014-1763, Ballantrae Woods

East/West Street: Rings Road	North/South Street: Avery Road
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	51	344	34	36	834	235
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	55	373	36	39	906	255
Percent Heavy Vehicles	3	--	--	3	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	29	9	43	11	4	13
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Hourly Flow Rate, HFR (veh/h)	31	9	46	11	4	14
Percent Heavy Vehicles	3	3	3	3	3	3
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR			LTR	
v (veh/h)	55	39		29			86	
C (m) (veh/h)	598	1144		98			113	
v/c	0.09	0.03		0.30			0.76	
95% queue length	0.30	0.11		1.12			4.24	
Control Delay (s/veh)	11.6	8.3		56.5			100.6	
LOS	B	A		F			F	
Approach Delay (s/veh)	--	--	56.5			100.6		
Approach LOS	--	--	F			F		

Copyright © 2010 University of Florida, All Rights Reserved

HCS+™ Version 5.6

Generated: 4/30/2015 9:36 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	29	9	43	11	4	13	51	344	34	36	834	235
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	32	10	47	12	4	14	55	374	37	39	907	255
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	128	22	69	129	36	65	160	1020	96	89	1056	291
Arrive On Green	0.08	0.08	0.08	0.08	0.08	0.08	0.77	0.77	0.77	0.77	0.77	0.77
Sat Flow, veh/h	480	262	831	462	436	786	113	1318	123	29	1365	376
Grp Volume(v), veh/h	89	0	0	30	0	0	466	0	0	1201	0	0
Grp Sat Flow(s),veh/h/ln	1573	0	0	1684	0	0	1555	0	0	1770	0	0
Q Serve(g_s), s	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0
Cycle Q Clear(g_c), s	3.0	0.0	0.0	0.9	0.0	0.0	4.3	0.0	0.0	25.8	0.0	0.0
Prop In Lane	0.36		0.53	0.40		0.47	0.12		0.08	0.03		0.21
Lane Grp Cap(c), veh/h	218	0	0	230	0	0	1275	0	0	1436	0	0
V/C Ratio(X)	0.41	0.00	0.00	0.13	0.00	0.00	0.37	0.00	0.00	0.84	0.00	0.00
Avail Cap(c_a), veh/h	615	0	0	620	0	0	1275	0	0	1436	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	24.7	0.0	0.0	23.8	0.0	0.0	1.9	0.0	0.0	4.3	0.0	0.0
Incr Delay (d2), s/veh	1.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	0.0	5.9	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.0	0.4	0.0	0.0	2.4	0.0	0.0	14.4	0.0	0.0
LnGrp Delay(d),s/veh	26.0	0.0	0.0	24.1	0.0	0.0	2.7	0.0	0.0	10.2	0.0	0.0
LnGrp LOS	C			C			A			B		
Approach Vol, veh/h		89			30			466			1201	
Approach Delay, s/veh		26.0			24.1			2.7			10.2	
Approach LOS		C			C			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		47.0		8.6		47.0		8.6
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		43.0		19.0		43.0		19.0
Max Q Clear Time (g_c+I1), s		6.3		5.0		27.8		2.9
Green Ext Time (p_c), s		22.1		0.4		11.6		0.5

Intersection Summary	
HCM 2010 Ctrl Delay	9.3
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	53	9	54	11	4	13	69	344	34	36	834	276
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1900	1863	1900	1900	1863	1900
Adj Flow Rate, veh/h	58	10	59	12	4	14	75	374	37	39	907	300
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	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
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	153	25	80	131	53	88	167	791	73	83	990	321
Arrive On Green	0.11	0.11	0.11	0.11	0.11	0.11	0.76	0.76	0.76	0.76	0.76	0.76
Sat Flow, veh/h	597	226	714	427	476	790	130	1045	97	29	1309	424
Grp Volume(v), veh/h	127	0	0	30	0	0	486	0	0	1246	0	0
Grp Sat Flow(s),veh/h/ln	1536	0	0	1693	0	0	1272	0	0	1762	0	0
Q Serve(g_s), s	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	0.0	0.0
Cycle Q Clear(g_c), s	4.8	0.0	0.0	1.0	0.0	0.0	5.3	0.0	0.0	35.3	0.0	0.0
Prop In Lane	0.46		0.46	0.40		0.47	0.15		0.08	0.03		0.24
Lane Grp Cap(c), veh/h	258	0	0	272	0	0	1031	0	0	1394	0	0
V/C Ratio(X)	0.49	0.00	0.00	0.11	0.00	0.00	0.47	0.00	0.00	0.89	0.00	0.00
Avail Cap(c_a), veh/h	486	0	0	499	0	0	1031	0	0	1394	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	26.1	0.0	0.0	24.4	0.0	0.0	2.4	0.0	0.0	6.0	0.0	0.0
Incr Delay (d2), s/veh	1.5	0.0	0.0	0.2	0.0	0.0	1.5	0.0	0.0	9.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.2	0.0	0.0	0.5	0.0	0.0	3.0	0.0	0.0	19.8	0.0	0.0
LnGrp Delay(d),s/veh	27.5	0.0	0.0	24.6	0.0	0.0	4.0	0.0	0.0	15.1	0.0	0.0
LnGrp LOS	C			C			A			B		
Approach Vol, veh/h		127			30			486			1246	
Approach Delay, s/veh		27.5			24.6			4.0			15.1	
Approach LOS		C			C			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		50.0		10.8		50.0		10.8
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		46.0		16.0		46.0		16.0
Max Q Clear Time (g_c+I1), s		7.3		6.8		37.3		3.0
Green Ext Time (p_c), s		24.8		0.5		7.5		0.6

Intersection Summary	
HCM 2010 Ctrl Delay	13.2
HCM 2010 LOS	B

MOVEMENT SUMMARY

Site: 2025 PM No Build

Liggett Tract
Rings Road/Cara Road & Avery Road
2025 PM No Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Avery Road											
3	L	109	3.0	0.574	14.2	LOS B	4.5	114.7	0.64	0.86	31.1
8	T	1040	3.0	0.574	7.9	LOS A	4.5	114.7	0.64	0.61	33.9
18	R	43	3.0	0.574	8.3	LOS A	4.5	114.7	0.64	0.66	33.6
Approach		1192	3.0	0.574	8.5	LOS A	4.5	114.7	0.64	0.63	33.6
East: Cara Road											
1	L	40	3.0	0.253	16.2	LOS B	1.1	28.2	0.76	0.95	22.1
6	T	14	3.0	0.253	7.3	LOS A	1.1	28.2	0.76	0.78	22.2
16	R	48	3.0	0.253	9.0	LOS A	1.1	28.2	0.76	0.82	23.1
Approach		102	3.0	0.253	11.6	LOS B	1.1	28.2	0.76	0.87	22.5
North: Avery Road											
7	L	41	3.0	0.789	13.4	LOS B	10.1	257.7	0.74	0.81	31.1
4	T	1547	3.0	0.789	8.5	LOS A	10.1	257.7	0.73	0.63	33.4
14	R	300	3.0	0.789	8.6	LOS A	9.9	254.6	0.72	0.65	32.9
Approach		1888	3.0	0.789	8.6	LOS A	10.1	257.7	0.73	0.64	33.3
West: Rings Road											
5	L	180	3.0	0.639	26.8	LOS C	3.9	100.3	0.90	1.10	22.9
2	T	37	3.0	0.639	16.6	LOS B	3.9	100.3	0.90	1.05	22.4
12	R	236	3.0	0.572	16.2	LOS B	3.6	91.7	0.90	1.05	25.9
Approach		453	3.0	0.639	20.4	LOS C	3.9	100.3	0.90	1.07	24.3
All Vehicles		3636	3.0	0.789	10.1	LOS B	10.1	257.7	0.72	0.70	31.5

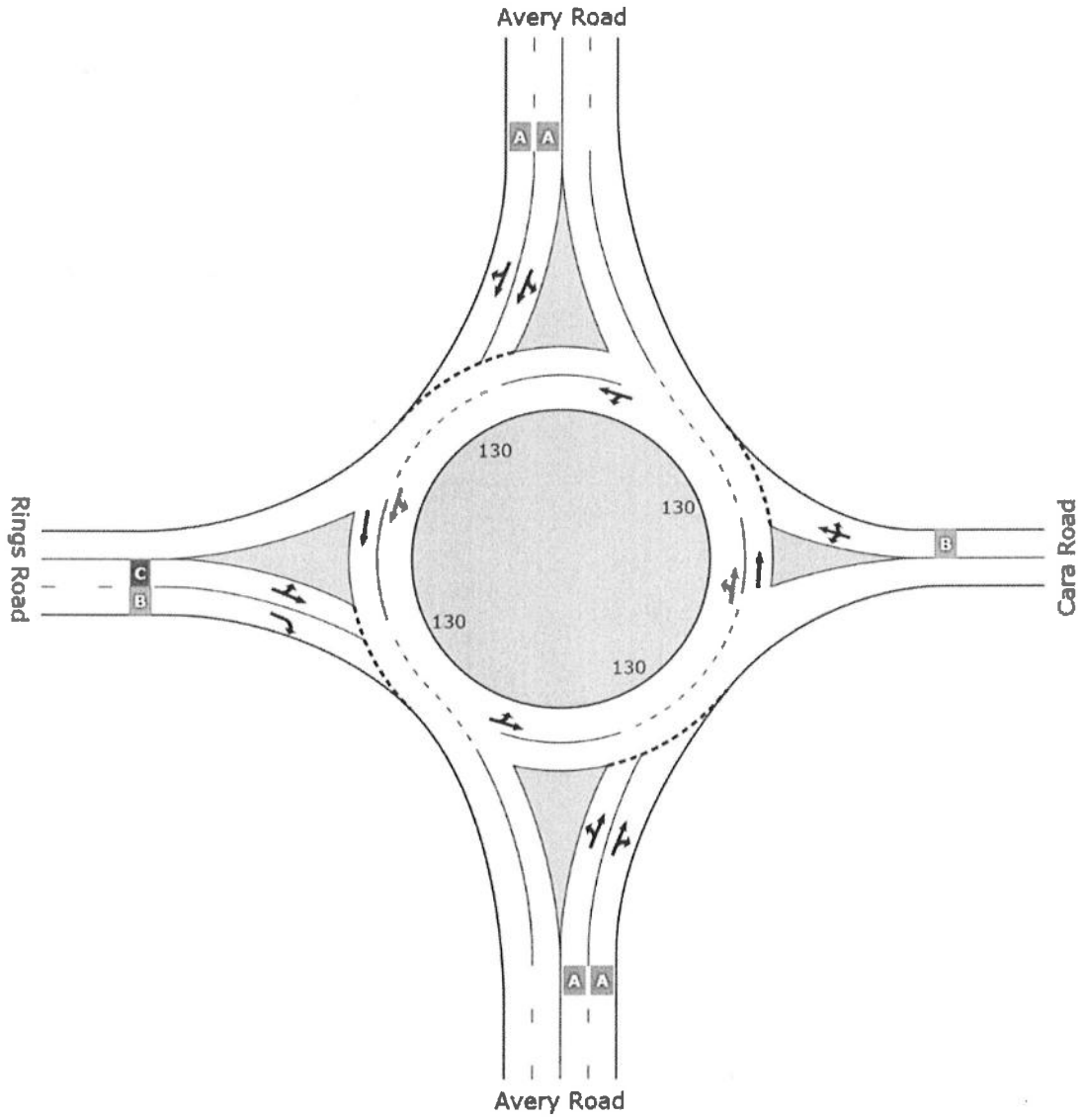
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 PM No Build

Liggett Tract
Rings Road/Cara Road & Avery Road
2025 PM No Build
Roundabout



	South	East	North	West	Intersection
LOS	A	B	A	C	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

MOVEMENT SUMMARY

Site: 2025 PM Build

Liggett Tract
Rings Road/Cara Road & Avery Road
2025 PM Build
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Avery Road											
3	L	128	3.0	0.601	14.8	LOS B	5.1	130.7	0.69	0.87	30.8
8	T	1040	3.0	0.601	8.5	LOS A	5.1	131.0	0.69	0.67	33.6
18	R	43	3.0	0.601	8.8	LOS A	5.1	131.0	0.69	0.72	33.3
Approach		1212	3.0	0.601	9.2	LOS A	5.1	131.0	0.69	0.69	33.3
East: Cara Road											
1	L	40	3.0	0.267	16.6	LOS B	1.2	30.2	0.77	0.95	22.0
6	T	14	3.0	0.267	7.7	LOS A	1.2	30.2	0.77	0.79	22.0
16	R	48	3.0	0.267	9.3	LOS A	1.2	30.2	0.77	0.83	23.0
Approach		102	3.0	0.267	12.0	LOS B	1.2	30.2	0.77	0.88	22.4
North: Avery Road											
7	L	41	3.0	0.827	14.7	LOS B	12.5	318.8	0.83	0.82	30.4
4	T	1547	3.0	0.827	9.8	LOS A	12.5	318.8	0.83	0.71	32.8
14	R	345	3.0	0.827	9.9	LOS A	12.4	316.9	0.82	0.72	32.4
Approach		1933	3.0	0.827	10.0	LOS A	12.5	318.8	0.83	0.71	32.7
West: Rings Road											
5	L	207	3.0	0.767	32.5	LOS C	5.4	138.7	0.94	1.18	21.1
2	T	37	3.0	0.767	22.4	LOS C	5.4	138.7	0.94	1.15	20.2
12	R	248	3.0	0.651	18.5	LOS B	4.4	112.3	0.93	1.09	24.8
Approach		491	3.0	0.767	24.7	LOS C	5.4	138.7	0.93	1.13	22.7
All Vehicles		3738	3.0	0.827	11.7	LOS B	12.5	318.8	0.79	0.77	30.7

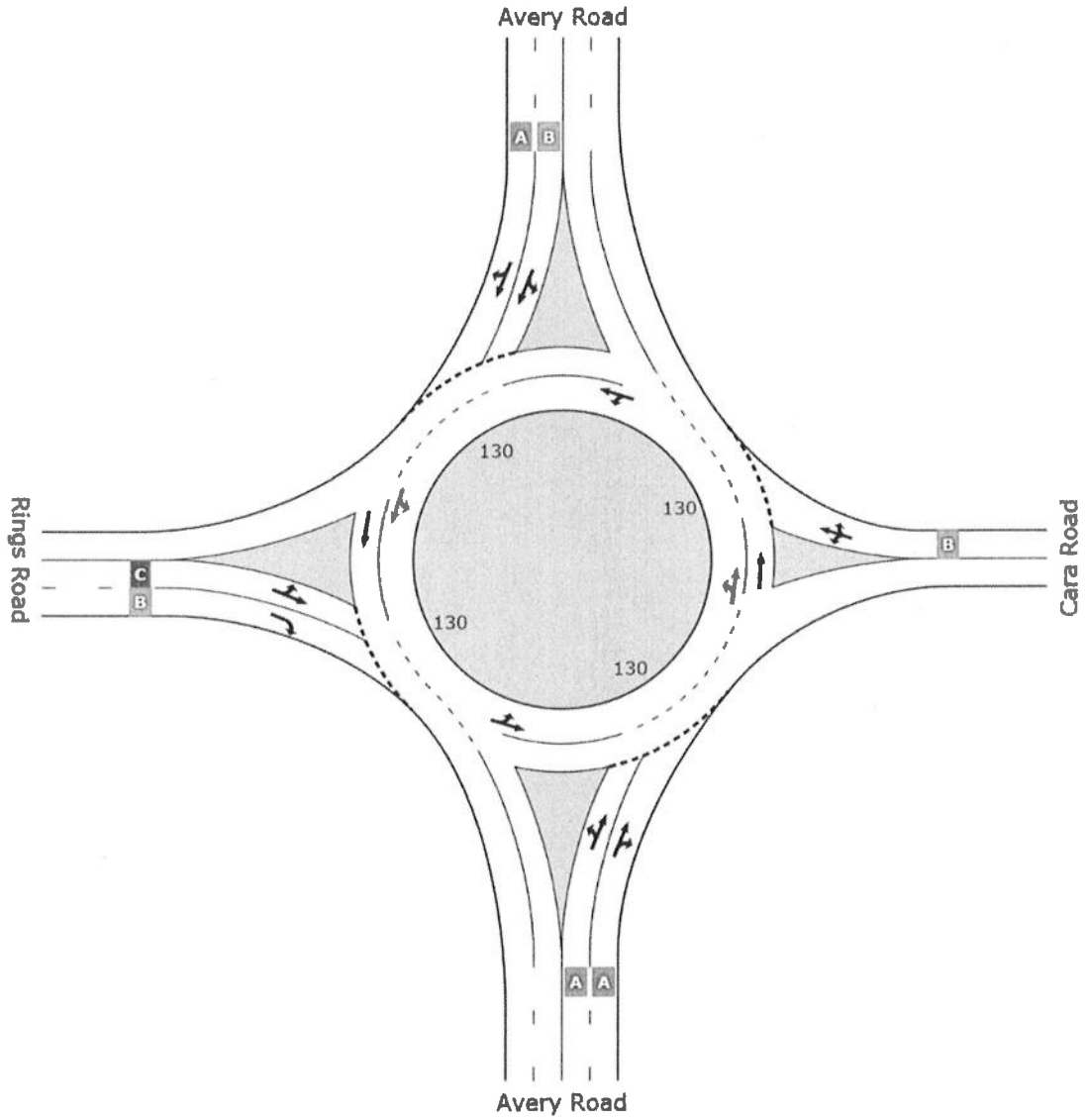
Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

LEVEL OF SERVICE SUMMARY

Site: 2025 PM Build

Liggett Tract
Rings Road/Cara Road & Avery Road
2025 PM Build
Roundabout



	South	East	North	West	Intersection
LOS	A	B	A	C	B

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model used.

Copyright © 2000-2011 Akcelik and Associates Pty Ltd
www.sidrasolutions.com

APPENDIX F
TURN LANE SIZING CALCULATIONS

Ballantrae Woods
Traffic Impact Study
Turn Lane Length Calculations

AM Peak Hour
2015 Build

Cosgray Rd & Churchman Rd		
Movement	**SBLT**	
Design Speed	45	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	164	vph
Number of Through Lanes	1	
Turning Volume	6	vph
Number of Turning Lanes	1	
Design Condition	C	A, B, or C
Turning Percentage	4%	
Vehicles Per Cycle	0.1	
Storage Length	50	feet
Deceleration/Taper	125	feet
Calculated Turn Lane Length	175	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

PM Peak Hour
2015 Build

Cosgray Rd & Churchman Rd		
Movement	**SBLT**	
Design Speed	45	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	594	vph
Number of Through Lanes	1	
Turning Volume	20	vph
Number of Turning Lanes	1	
Design Condition	C	A, B, or C
Turning Percentage	3%	
Vehicles Per Cycle	0.3	
Storage Length	50	feet
Deceleration/Taper	125	feet
Calculated Turn Lane Length	175	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

AM Peak Hour
2025 Build

Cosgray Rd & Churchman Rd		
Movement	**SBLT**	
Design Speed	45	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	218	vph
Number of Through Lanes	1	
Turning Volume	8	vph
Number of Turning Lanes	1	
Design Condition	C	A, B, or C
Turning Percentage	4%	
Vehicles Per Cycle	0.1	
Storage Length	50	feet
Deceleration/Taper	125	feet
Calculated Turn Lane Length	175	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

PM Peak Hour
2025 Build

Cosgray Rd & Churchman Rd		
Movement	**SBLT**	
Design Speed	45	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	790	vph
Number of Through Lanes	1	
Turning Volume	43	vph
Number of Turning Lanes	1	
Design Condition	C	A, B, or C
Turning Percentage	5%	
Vehicles Per Cycle	0.7	
Storage Length	50	feet
Deceleration/Taper	125	feet
Calculated Turn Lane Length	175	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

Ballantrae Woods
Traffic Impact Study
Turn Lane Length Calculations

AM Peak Hour
2025 No Build

Rings Rd & Eiterman Rd		
Movement	**EBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	295	vph
Number of Through Lanes	1	
Turning Volume	132	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	31%	
Vehicles Per Cycle	2.2	
Storage Length	100	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	150	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

PM Peak Hour
2025 No Build

Rings Rd & Eiterman Rd		
Movement	**EBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	282	vph
Number of Through Lanes	1	
Turning Volume	31	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	10%	
Vehicles Per Cycle	0.5	
Storage Length	50	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	100	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

AM Peak Hour
2025 Build

Rings Rd & Eiterman Rd		
Movement	**EBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	348	vph
Number of Through Lanes	1	
Turning Volume	132	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	28%	
Vehicles Per Cycle	2.2	
Storage Length	100	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	150	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

PM Peak Hour
2025 Build

Rings Rd & Eiterman Rd		
Movement	**EBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	317	vph
Number of Through Lanes	1	
Turning Volume	31	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	9%	
Vehicles Per Cycle	0.5	
Storage Length	50	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	100	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

Ballantrae Woods
Traffic Impact Study
Turn Lane Length Calculations

AM Peak Hour
2025 Build

Chruchman Dr. & Drive A		
Movement	**NBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	78	vph
Number of Through Lanes	1	
Turning Volume	4	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	5%	
Vehicles Per Cycle	0.1	
Storage Length	50	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	100	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

PM Peak Hour
2025 Build

Chruchman Dr. & Drive A		
Movement	**NBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	23	vph
Number of Through Lanes	1	
Turning Volume	13	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	36%	
Vehicles Per Cycle	0.2	
Storage Length	50	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	100	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

AM Peak Hour
2025 Build

Chruchman Dr. & Drive B / Marmion Dr.		
Movement	**NBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	201	vph
Number of Through Lanes	1	
Turning Volume	8	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	4%	
Vehicles Per Cycle	0.1	
Storage Length	50	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	100	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

PM Peak Hour
2025 Build

Chruchman Dr. & Drive B / Marmion Dr.		
Movement	**NBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	51	vph
Number of Through Lanes	1	
Turning Volume	25	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	33%	
Vehicles Per Cycle	0.4	
Storage Length	50	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	100	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

AM Peak Hour
2025 Build

Chruchman Dr. & Drive C / Montridge Ln.		
Movement	**NBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	409	vph
Number of Through Lanes	1	
Turning Volume	8	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	2%	
Vehicles Per Cycle	0.1	
Storage Length	50	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	100	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

PM Peak Hour
2025 Build

Chruchman Dr. & Drive C / Montridge Ln.		
Movement	**NBLT**	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Stop	
Through Volume	106	vph
Number of Through Lanes	1	
Turning Volume	25	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	19%	
Vehicles Per Cycle	0.4	
Storage Length	50	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	100	feet
No Block Distance	N.A.	feet
No Block Turn Lane Length	N.A.	feet

APPENDIX G
SITE TRAFFIC PERCENTAGES BY INTERSECTION

Percent of Site Traffic Entering Intersection

2025 Full Build Traffic Volumes w/ Churchman Dr connected)

AM&PM Peak Hour
o=k(am)+k(pm)

	TH	LT	69	RT																		
	1008	51	36	LT	Churchman Dr																	
			1053	27																		
			TH	RT		SITE																
			44	RT								Eiterman Rd										
RT	TH	LT	117	TH			RT	LT	442	RT	RT	LT	88	RT		RT	TH	LT	110	RT		
71	948	32	364	LT			80	329	495	TH	94	84	843	TH		631	1978	45	27	TH		
	LT	62	137	974	358		LT	110			LT	163					LT	486	63	LT		
	TH	114	LT	TH	RT		TH	500			TH	665					TH	71	383	2778	62	
	RT	104															RT	338	LT	TH	RT	
		Cosgray Rd																Avery Rd				

Site trip assignment (w Churchman Dr connected)

AM & PM Peak Hour
p=h1(am)+h1(pm)

	TH	LT	23	RT																		
	0	20	13	LT	Churchman Dr																	
			6	12																		
			TH	RT								Eiterman Rd										
			13	RT															0	RT		
RT	TH	LT	2	TH			RT	LT	70		RT	LT		RT		RT	TH	LT	0	TH		
2	4	15	10	LT			18	81	7		0	0	77	TH		53	0	0	0	LT		
	LT	1	0	4	8		LT	16			LT	0					LT	61	23	0	0	
	TH	1	LT	TH	RT		TH	8			TH	88					TH	0	LT	TH	RT	
	RT																RT	27				
		Cosgray Rd																Avery Rd				