Traffic Impact Study
Tipton Mixed Use Development

Love's Travel Stops & Country Stores
10601 N. Pennsylvania Avenue
Oklahoma City, Oklahoma 73120

PREPARED

CHRISTOPHER B. BURKE ENGINEERING, LLC
PNC Center
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Suite 1368 South Tower
Indianapolis, IN 46204

Application No.:

June 22, 2015

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Preparer Qualifications

I certify that this TRAFFIC IMPACT STUDY has been prepared by me or under my immediate supervision and that I have experience and training in the field of traffic and transportation engineering.

_____
George M. Ziegler, P.E.
Indiana Registration No. 10910736
Christopher B. Burke Engineering, LLC

1.0 Study Purpose and Executive Summary

1.1 Purpose of Report and Study Objectives

This Traffic Impact Study (TIS) is being submitted prior to the site plan approval request for driveway access to SR 28 and to construct improvements within the State's right-of-way including the driveway access point and recommended roadway improvements included in this report.

This TIS includes three study conditions:

- Baseline Study of the Existing Background Traffic
- Impacts from the Proposed One (1) Year Development Plan
- Impacts from the Proposed Five (5) Year Development Plan

The purpose of this Traffic Impact Study is to determine if the Proposed Development Plans can be accommodated within the current transportation infrastructure for the study conditions as outlined in this report. If the development cannot be accommodated within the current transportation infrastructure this report will determine the recommended improvements for operating conditions consistent with Indiana Department of Transportation (INDOT) policy.

The following report summarizes CBBEL's findings and conclusions of the traffic impact of the Proposed One (1) Year Development Plan as well as the future Five (5) Year Development Plan. Also included are recommendations for the design of the site and the surrounding roadway network.

1.2 Executive Summary

Site Location and Study Area

Christopher B. Burke Engineering, LLC (CBBEL) conducted a Traffic Impact Study (TIS) for the Proposed One (1) Year Development Plan and Proposed Five (5) Year Development Plan at the northwest quadrant of Indiana State Route 28 and US Route 31 in Tipton County, Indiana. The site is bounded by US Route 31 to the east, Indiana SR 28 to the south, and agricultural properties to the west and north. The existing land use at the site is agricultural with a single detached residential unit. The project location is illustrated in Figures 1 and 2.

Currently INDOT is designing a grade separated interchange to replace the existing signalized intersection of State Route 28 and US Route 31. The proposed geometry is a roundabout interchange and an illustration of the design provided by INDOT is shown in Figure 3.

The TIS Study will compare the baseline traffic conditions to the Proposed One (1) Year and Five (5) Year Development Plans. Site access is planned from Indiana SR 28 west of the proposed interchange with US Route 31.

Description for Proposed One (1) Year Development Plan

The One (1) Year Development Plan will consist of a Love's gas station and truck stop facility with attached convenience store, and fast food restaurant with drive through lane. The discussion on site generated traffic for this development is included in Section 3.0. The construction of the Love's Travel Stop facility is planned for 2016.

Description of Proposed Five (5) Year Development Plan

The Five (5) Year Development Plan will consist of approximately 31.63 acres of commercial land uses and represents the site's full build-out condition. The Five (5) Year Development Plan includes the Love's Travel Stop with the remainder of the parcel developed. It is anticipated the additional development will include fast food restaurants, discount retail stores, automobile sales, and an 80 room hotel. The construction start date for the Five (5) Year Development plan is to be determined.

Findings

CBBEL performed a capacity analyses for the intersection of the Site Access Drive and Indiana Route 28 and the proposed ramp roundabout using the One Way Stop Control, Signalized Intersection, and Roundabout alternatives for the subject site access point for the One (1) Year Development Plan and the Signalized Intersection and a Roundabout for the Five (5) Year Development Plan. Below are tables illustrating the results for the Site Access intersection. Additional capacity analysis discussion is included in Section 6.0.

Table 1: One (1) Year Development Plan Capacity Analysis Site Access Drive and Indiana Route 28

		One (1) Year Development Plan			
		EB	**WB**	**SB**	**Intersection**
One-Way Stop Controlled	AM	-	-	12.0 - B	3.9 - A
	PM	-	-	12.8 - B	4.5 - A
Signalized Intersection	AM	4.3 - A	4.5 - A	18.6 - B	8.5 - A
	PM	4.6 - A	5.7 - A	17.5 - B	9.2 - A
Roundabout	AM	6.0 - A	5.5 - A	5.3 - A	5.6 - A
	PM	5.1 - A	6.8 - A	6.3 - A	6.4 - A

Table 2: Five (5) Year Development Plan Capacity Analysis Site Access Drive and Indiana Route 28

		Five (5) Year Development Plan			
		EB	**WB**	**SB**	**Intersection**
Signalized Intersection	AM	9.3 - A	7.2 - A	18.5 - B	11.6 - B
	PM	12.3 - B	9.7 - A	16.8 - B	12.8 - B
Roundabout	AM	10.0 - A	11.8 - B	9.8 - A	10.7 - B
	PM	9.7 - A	19.1 - C	18.8 - C	18.2 - C

Conclusions and Recommendations

The One (1) Year Development volumes do not meet traffic signal warrants, but do meet INDOT design criteria (Figure 46-4A) for an auxiliary right turn lane on the east approach.

The Five (5) Year Development volumes do meet traffic signal warrants, but the roundabout alternative is recommended due to the adjacent interchange design.

A full discussion regarding the results of the study is included in Section 8.0.

2.0 Proposed Development and Area Conditions

2.1 Subject Site

The site is located on the northwest quadrant of US Route 31 and S.R. 28 in Tipton, Indiana. The project location is illustrated in Figures 1 and 2.

Area Land Uses

CBBEL conducted field reconnaissance in April 2015, of the roadway characteristics, traffic control, traffic patterns, and adjacent land uses. The existing conditions for the development site and surrounding facilities are described below.

The area north, south, and west of the site consists primarily of agricultural land uses, while restaurant and gas station and motel land uses are located at the existing intersection of State Route 28 and US Route 31. It was noted that most of the businesses are currently unoccupied; possibly due to the land acquisition process from the INDOT interchange project. Directly east of US Route 31 is a Chrysler Transmission Plant. Directly south of the project site across State Route 28 is a small cemetery with a gravel access drive.

Existing Transportation Network

The proposed site is adjacent to Indiana Route 28 and US Route 31. The existing characteristics of these roadways are described below.

Indiana Route 28 is an east-west two-lane classified as a rural Other Principal Arterial east of US 31 and as a Rural Minor Arterial west of US 31. The existing geometry has auxiliary left turn lanes for Indiana Route 28 at the signalized intersection with US 31. The posted speed limit in the vicinity of the site is currently 55 miles per hour. Indiana Route 28 is a marked State route under the jurisdiction of INDOT.

US Route 31 is a north-south divided four lane road classified as a Rural Other Principal Arterial with a 60 miles per hour posted speed limit. The existing geometry has auxiliary left and right turn lanes for US Route 31 at the signalized intersection with Indiana Route 28. US Route 31 is a marked US route under the jurisdiction of INDOT.

Proposed Transportation Network

INDOT is currently designing a roundabout interchange to replace the existing signalized intersection of US Route 31 and Indiana State Route 28. A schematic with INDOT's preliminary interchange design has been included in Figure 3.

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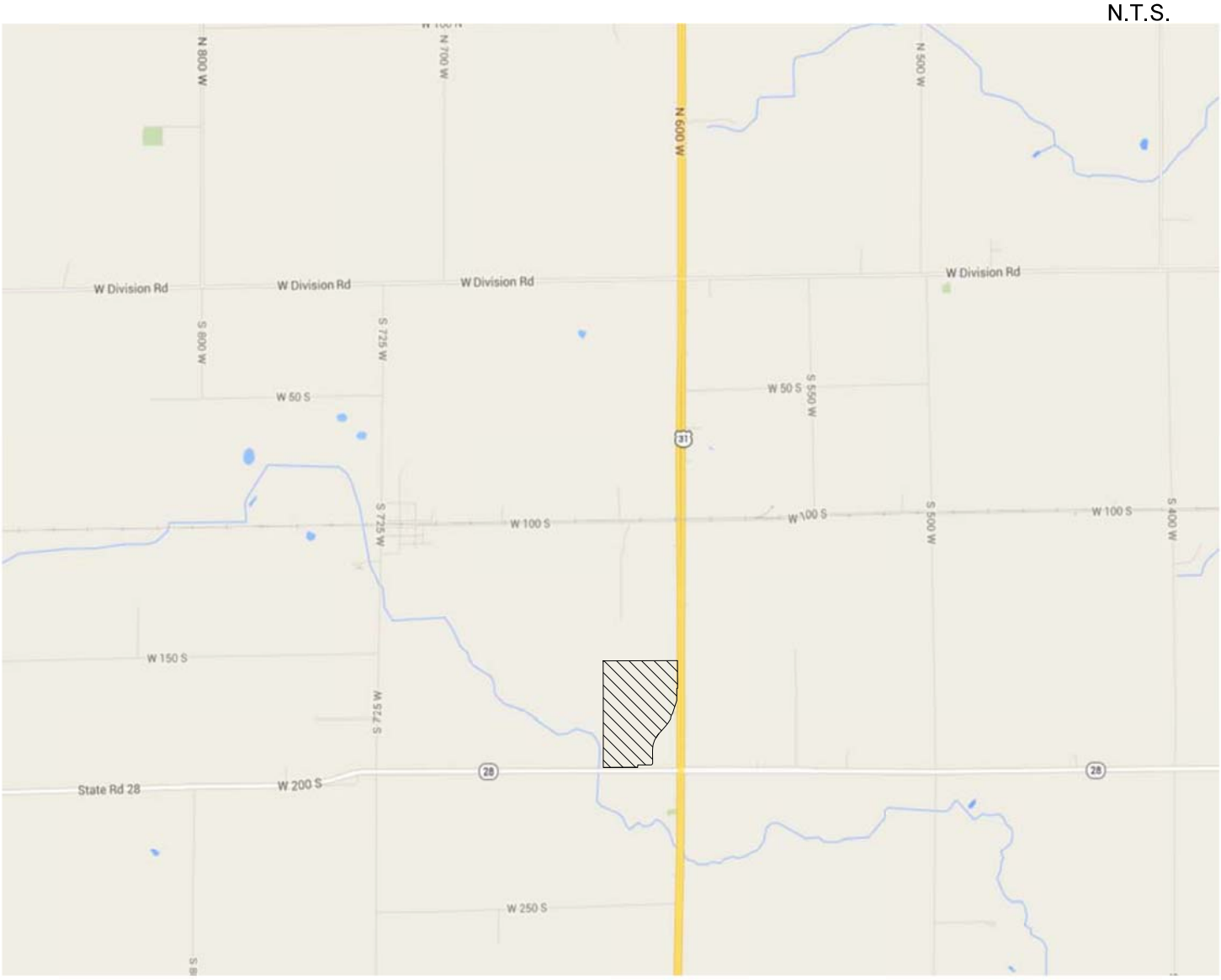

PROJECT SITE LOCATION
TIPTON, INDIANA

CHRISTOPHER B. BURKE ENGINEERING, LLC
115 West Washington Street, Suite 1368 South
Indianapolis, Indiana 46204
(317) 266-8000

CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **LOCATION MAP**

PROJECT NO. 140337.00002
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SHEET NO. FIG-01

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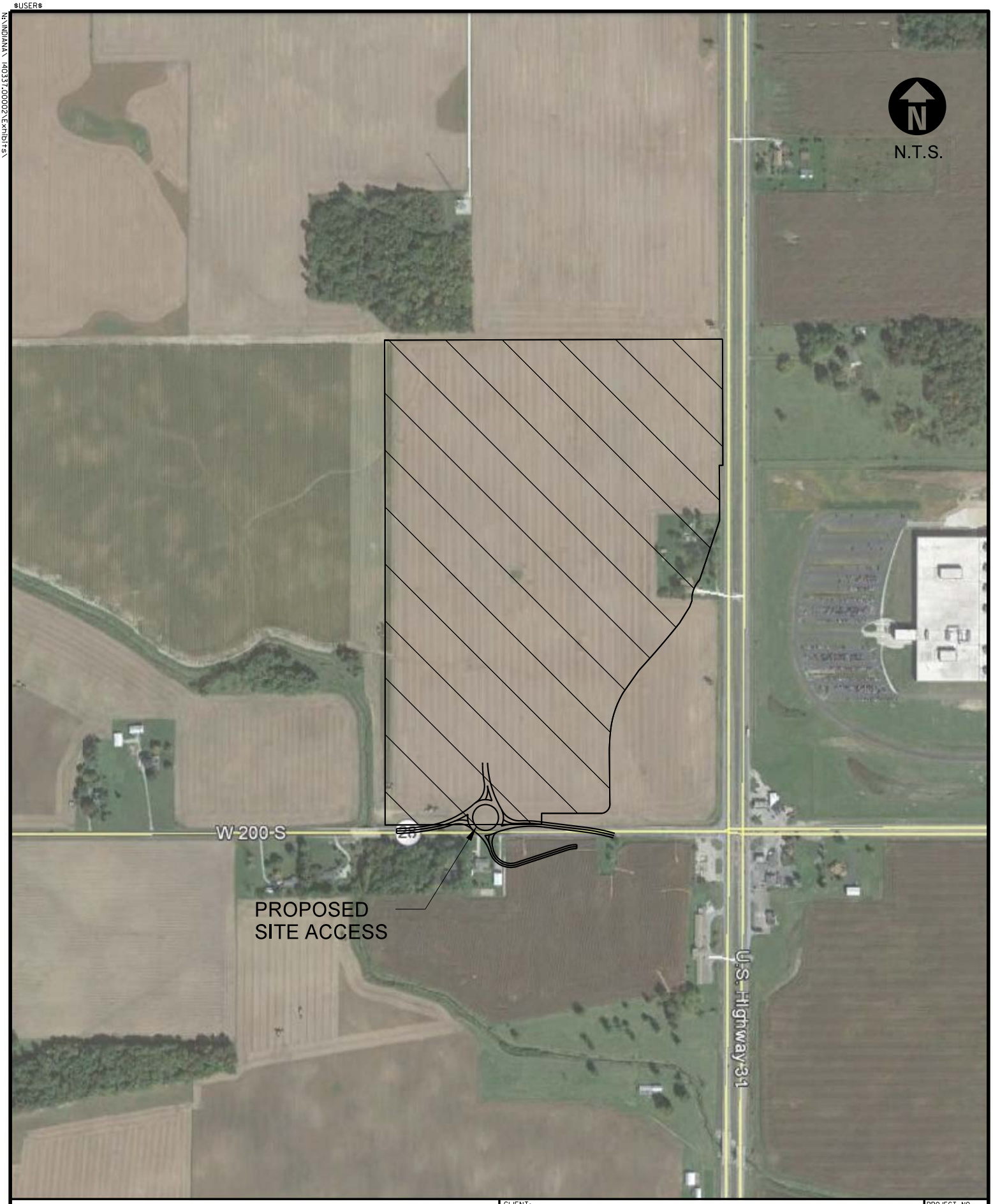

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TITLE: **AERIAL MAP**

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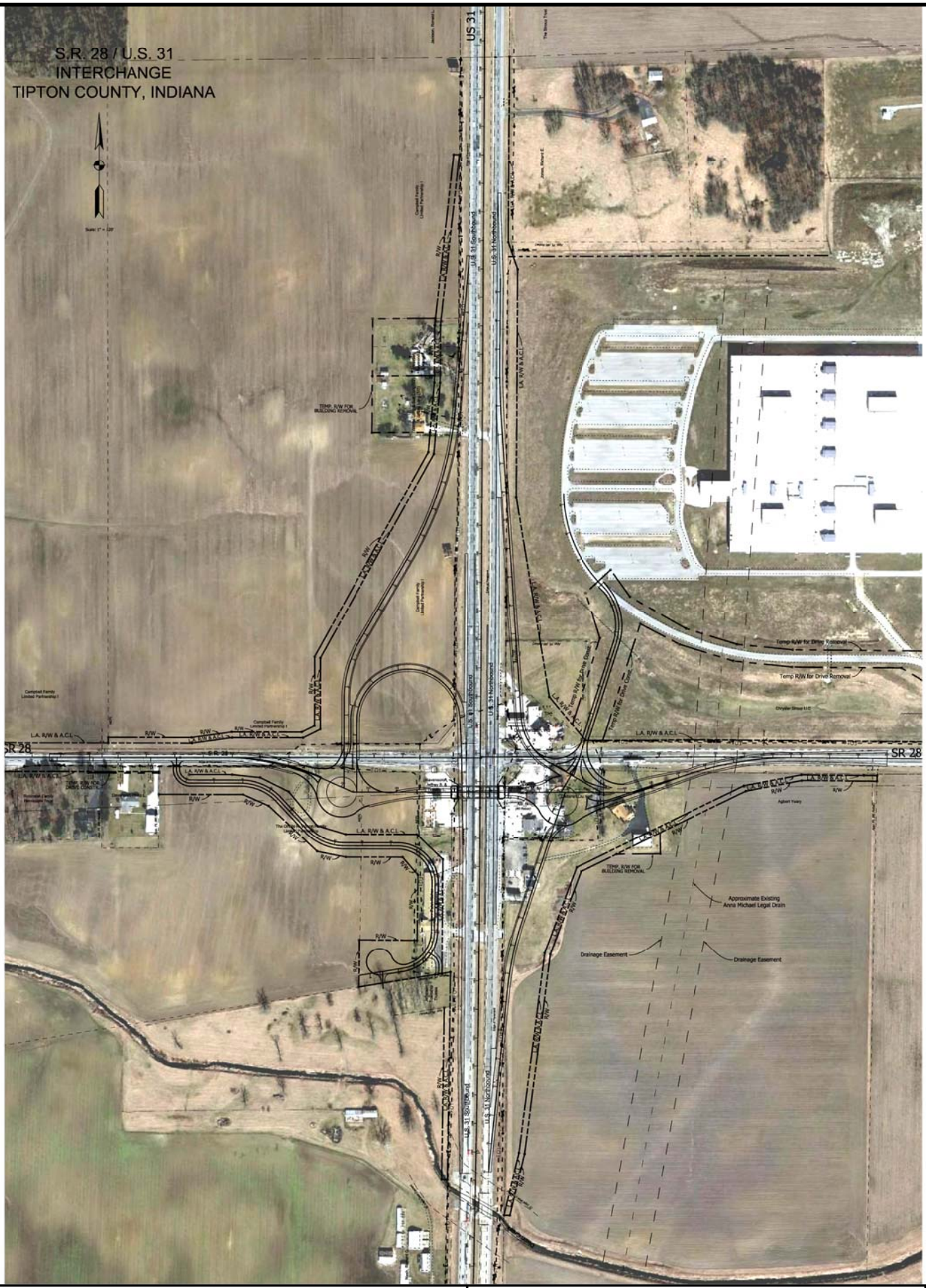

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CLIENT:
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TITLE:
PROPOSED ROUNDABOUT INTERCHANGE

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140337.00002

DATE:
5-8-2015

SHEET NO.
FIG–03

Roadway Access

The proposed development will have an access point on Indiana Route 28, approximately 635 feet west of the US 31 southbound roundabout. CBBEL performed the capacity analyses for the intersection using the One Way Stop Control, Signalized Intersection, and Roundabout alternatives to evaluate the traffic operations at the site entrance. The capacity analyses are included in Section 6.0.

Zoning

The existing parcel for the planned development is zoned commercial.

Existing Volumes

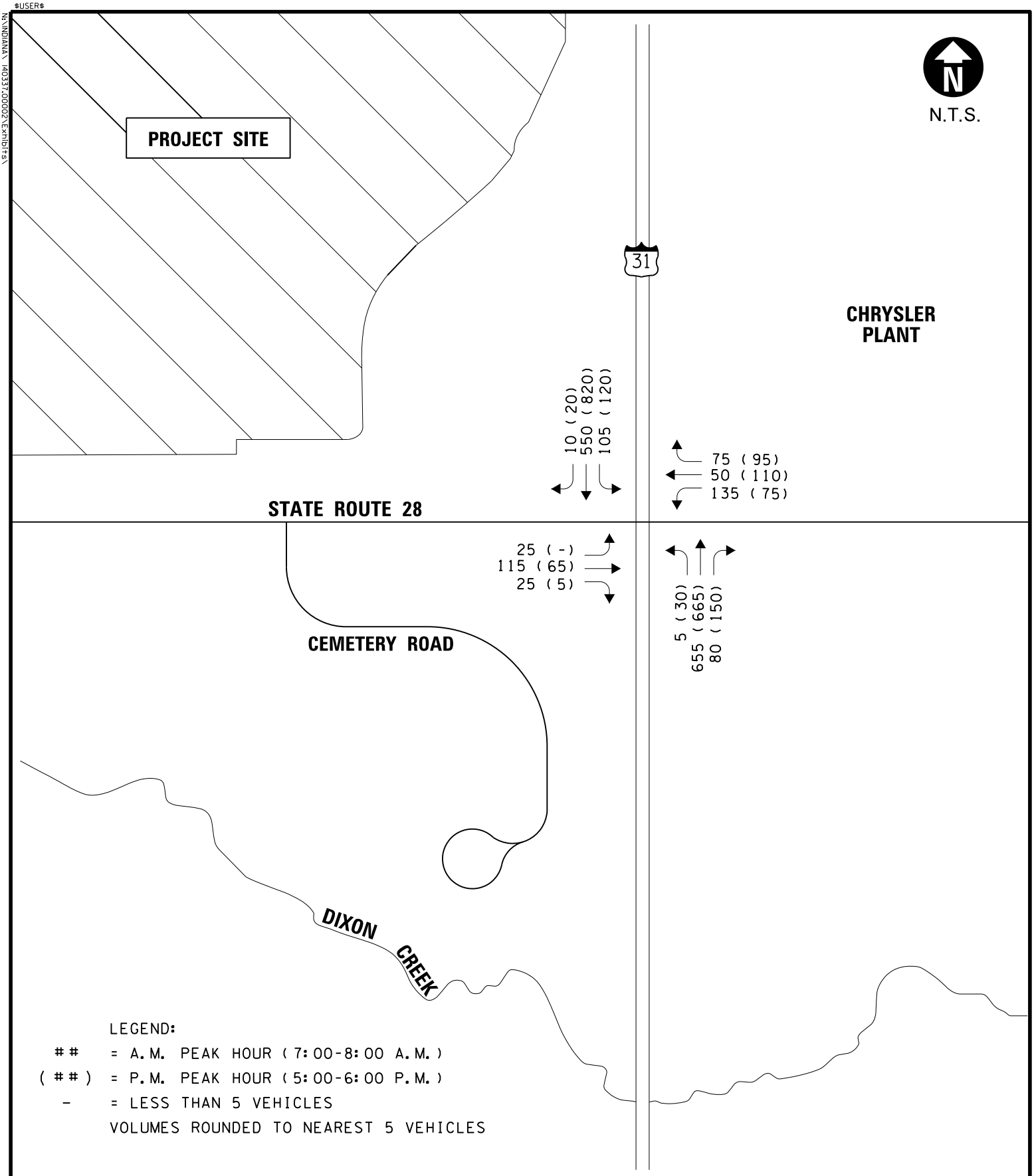
Manual turning movement counts for the AM and PM peak periods were provided by INDOT for the existing intersection of US Route 31 and Indiana Route 28. The peak hour was recorded from 7am to 8am and 5pm to 6pm for Indiana Route 28. In addition, CBBEL gathered average daily traffic (ADT) volumes on March 26, 2015 for Indiana Route 28 both east and west of the US 31 intersection. CBBEL's data shows an ADT of 6,535 east of US 31 and an ADT of 3,001 west of US 31. ADT data on INDOT's website shows an ADT of 5,040 east of US 31 and an ADT of 2,853 west of US 31. The analysis ultimately used the volumes provided by INDOT to match the analysis used for the roundabout interchange.

Existing traffic volumes are shown in Figure 4 with redistributed volumes in Figure 5. The ADT traffic count data gathered by CBBEL is included in Appendix A.

2.2 Proposed Development

The project site was analyzed for three conditions: baseline study, One (1) Year Development and Five (5) Year Development. The One (1) Year Development plan consists of a Love's Travel Stop facility in the southeast corner of the parcel. The second condition is the future Five (5) Year Development plan, which consists of a full build-out of the parcel with forecasted land uses in addition to the Love's Travel Stop. The associated land uses and site generated traffic volumes for both conditions are included in Section 3.0.

The preliminary site plans for both conditions are illustrated in Figures 6 and 7.



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CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **EXISTING TRAFFIC VOLUMES WITH EXISTING GEOMETRY**

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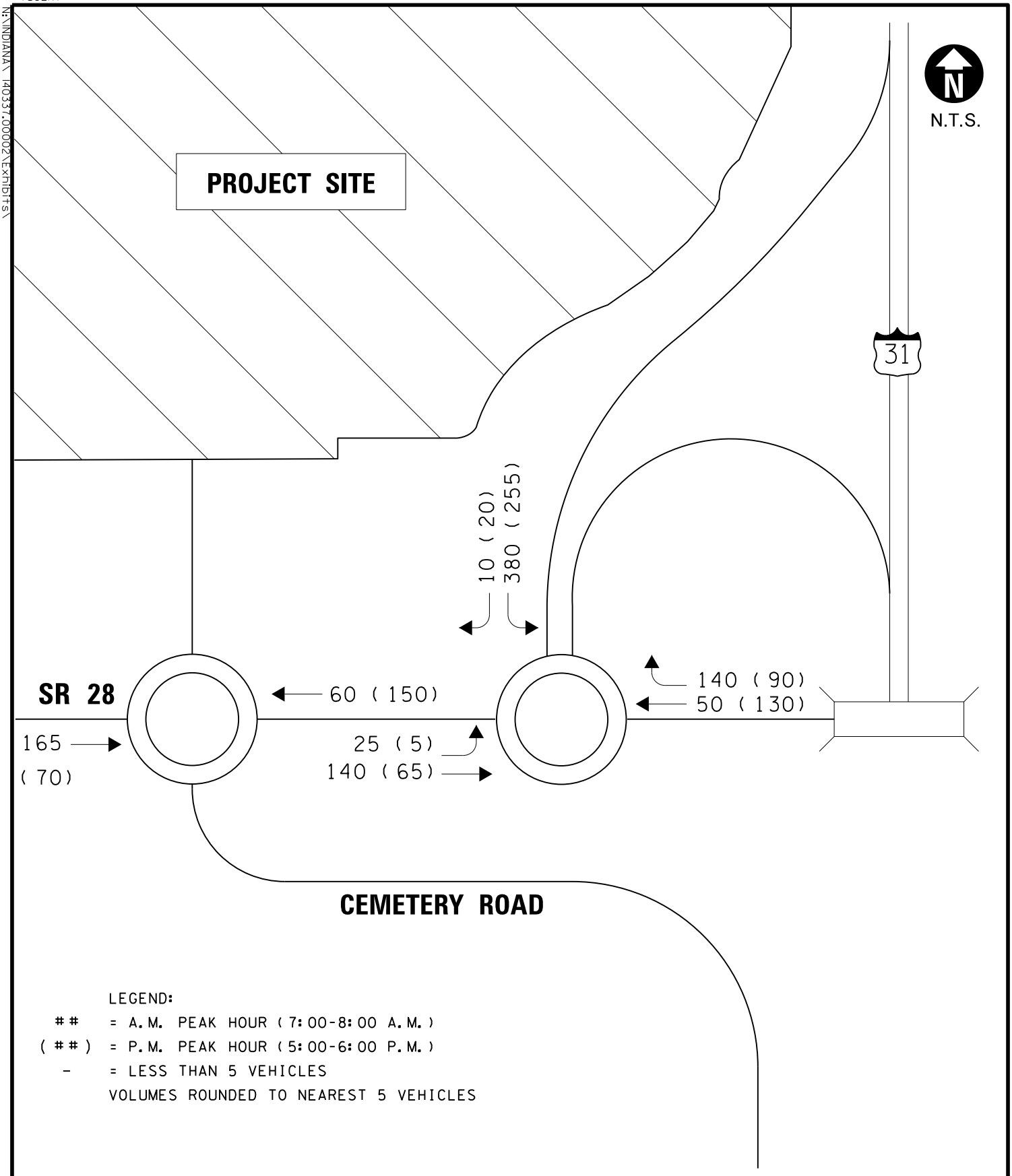

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-	= LESS THAN 5 VEHICLES

VOLUMES ROUNDED TO NEAREST 5 VEHICLES

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TITLE: **EXISTING TRAFFIC VOLUMES WITH ROUNDABOUT INTERCHANGE**

PROJECT NO. 140337.00002
DATE: 5-8-2015
SHEET NO. FIG-05

Dixon Creek

STATE ROUTE 28

Detention Pond

SITE ACCESS DRIVE

N

Parcel #1

Love's Travel Plaza

US ROUTE 31

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CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **ONE (1) YEAR DEVELOPMENT PLAN**

PROJECT NO. 140337.00002

DATE: 5-8-2015

SHEET NO. **FIG–06**

Dixon Creek

STATE ROUTE 28

Detention Pond

Parcel #2
Fast Food

Parcel #3
Fast Food

Parcel #4
Fast Food

FUTURE ROADWAY

Parcel #5
Discount Retail

N

SITE ACCESS DRIVE

Parcel #1

Hotel (80 rooms)

Parcel #6
Automobile Sales

FUTURE ROADWAY

Parcel #7
Discount Retail

US ROUTE 31

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CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **FIVE (5) YEAR DEVELOPMENT PLAN**

PROJECT NO. 140337.00002

DATE: 5-8-2015

SHEET NO. **FIG–07**

3.0 One Year Development Plan (Love's Travel Stop)

The following section describes the estimated trip ends generated by the proposed Love's Travel Stop facility and the procedures used to develop those estimates.

The estimates of traffic to be generated by the site are based upon the proposed land use type and size. Traffic generation estimates for the proposed development are determined using rates and fitted curve equations published in the Institute of Transportation Engineers Trip Generation, 9th Edition (ITE Report).

3.1 Site Generated Traffic

The rates and equations shown in Table 3 were used to estimate trips generated by the Love's site. They reflect typical trip ends based on the rates in the ITE Report. Table 4 summarizes the number of vehicles anticipated to be generated at the Love's site. These volumes are based on the generation rates and the size (dependent variable) of each proposed land use.

Table 3: One Year Development Plan Trip Generation Rates

Land Use [ITE Land Use Code]	Daily (trips/day/unit)	AM Peak (trips/hour/unit)	PM Peak (trips/hour/unit)
Fast-Food Restaurant with Drive-Through Window [934] (Trips/1000 s.f.)	T = 496.12(X)	T = 45.42 (X)	T = 32.65(X)
Gasoline/Service Station with Convenience Market [945] (Trips/Fueling Stations)	T = 162.78(X)	T = 10.16(X)	T = 13.51(X)
Tire Store [848] (Trips/Service Bays)	No Equation Given	T = 2.1(X)	T = 3.54(X)

s.f. = Square feet
X = Independent variable (i.e. 1000 s.f. of floor area)
T = Estimated trip ends; based on ITE Report Average Rate

Table 4: One Year Development Plan Site Traffic Generation

Building Number [ITE Land Use Code]	**Size**	**Average Daily Trips**	**AM**			**PM**		
			In	Out	Total	In	Out	Total
Fast Food Restaurant with Drive Through – [934]	2,800 s.f.	1,390	65	60	125	50	45	95
Gas Station with Convenience Store– [945]	26 fuel stations	4,230	130	130	260	175	175	350
Tire Store [848]	2 service bays		5	0	5	5	5	10
Total		**5,620**	**200**	**190**	**390**	**230**	**225**	**455**

s.f.= Square feet

Estimated trip ends for based on ITE Report Average Rates

It should be noted that this type of site, which includes a co-located gas station, convenience store, and fast-food restaurant, generally experiences a significant amount of internal capture trips, which would reduce the total number of trips added to the roadway network. However, CBBEL has conducted this analysis on the basis of the full trip generation estimates from the ITE Report, which reflects the traffic expected if all the customers of the gas station, tire store and restaurant arrived at the site independently. Pass-by trips and internal trips were not deducted from the volumes in an effort to present a more conservative analysis.

3.2 Trip Distribution

The direction of vehicles traveling around the development site is influenced by several factors, such as site access locations, land uses, congestion, nearby traffic generators, the area road network, and travel patterns of existing traffic. This distribution was estimated based on existing traffic patterns and the proximity of US Route 31. The estimated directional distribution for the Love's site is shown in Table 5 and Figure 8.

Table 5: Directional Distribution

Roadway Segment	Percent of Site Generated Traffic
Indiana Route 28 East	20%
Indiana Route 28 West	10%
US Route 31 North	35%
US Route 31 South	35%
Total	**100%**

3.3 Site Traffic Assignment

The site traffic assignment for the Love's development is based on the application of the directional distribution estimates (Table 5) to the site generated traffic volumes (Table 4). The site traffic assignment for the weekday morning and evening peak hours is shown in Figure 10.

3.4 Background Traffic Growth

CBBEL utilized background traffic volume growth rates provided by INDOT for traffic volumes on Indiana Route 28. Based on the data provided, CBBEL

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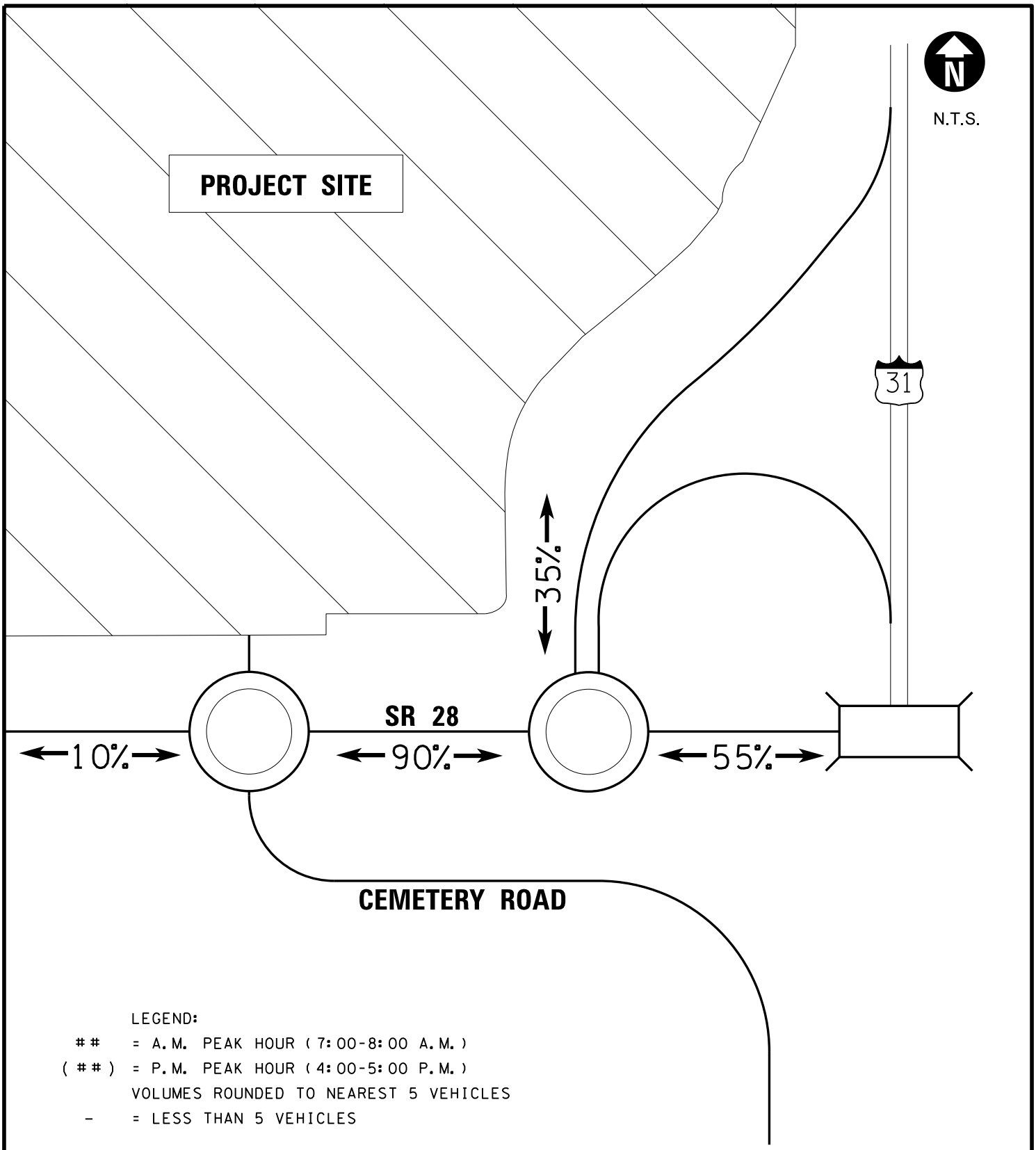

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	VOLUMES ROUNDED TO NEAREST 5 VEHICLES
-	= LESS THAN 5 VEHICLES

←## → = PERCENT DISTRIBUTION

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CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **DIRECTIONAL DISTRIBUTION FOR SITE GENERATED TRAFFIC**

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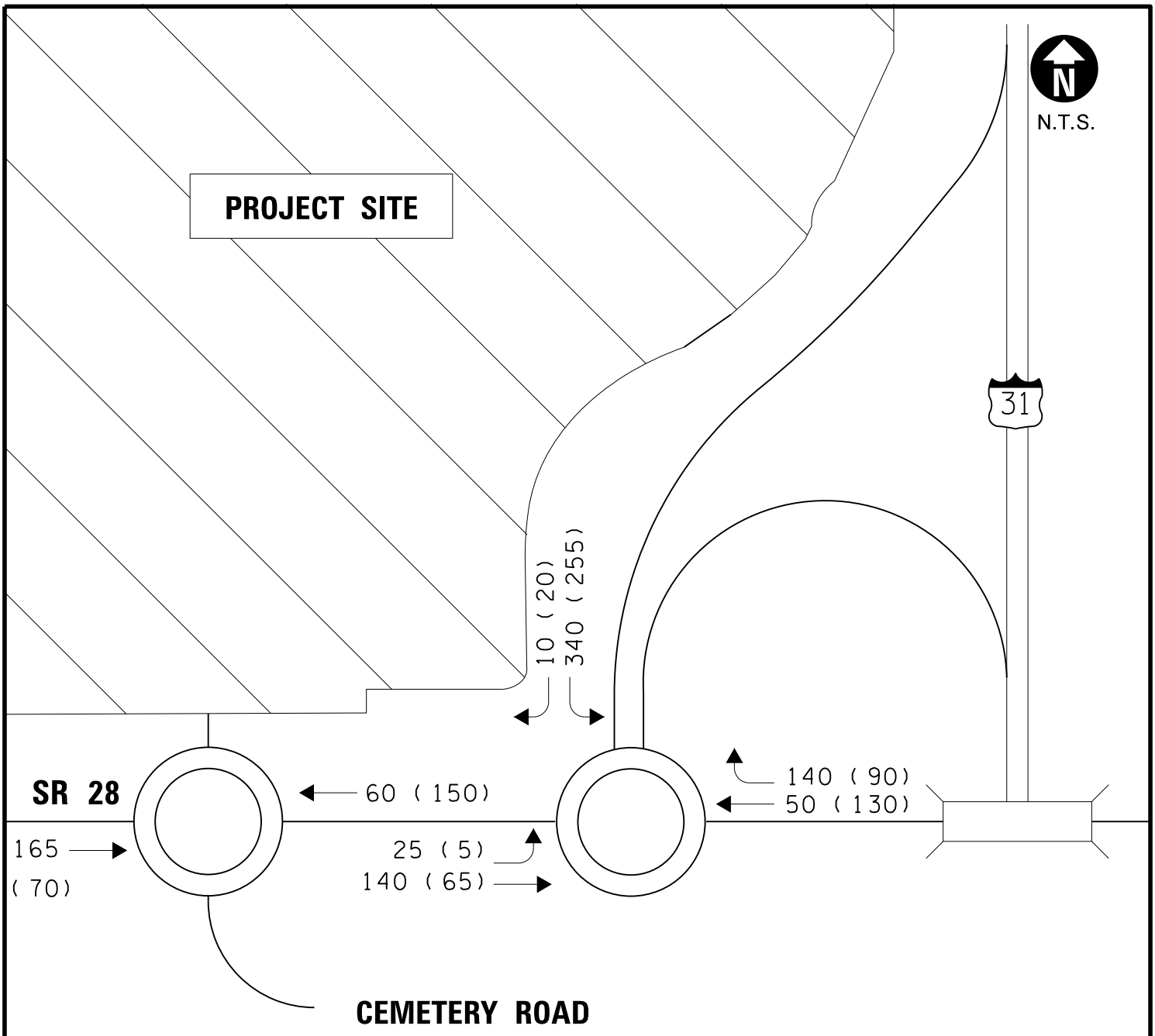

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VOLUMES ROUNDED TO NEAREST 5 VEHICLES

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CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **2016 BACKGROUND TRAFFIC VOLUMES**

PROJECT NO. 140337.00002
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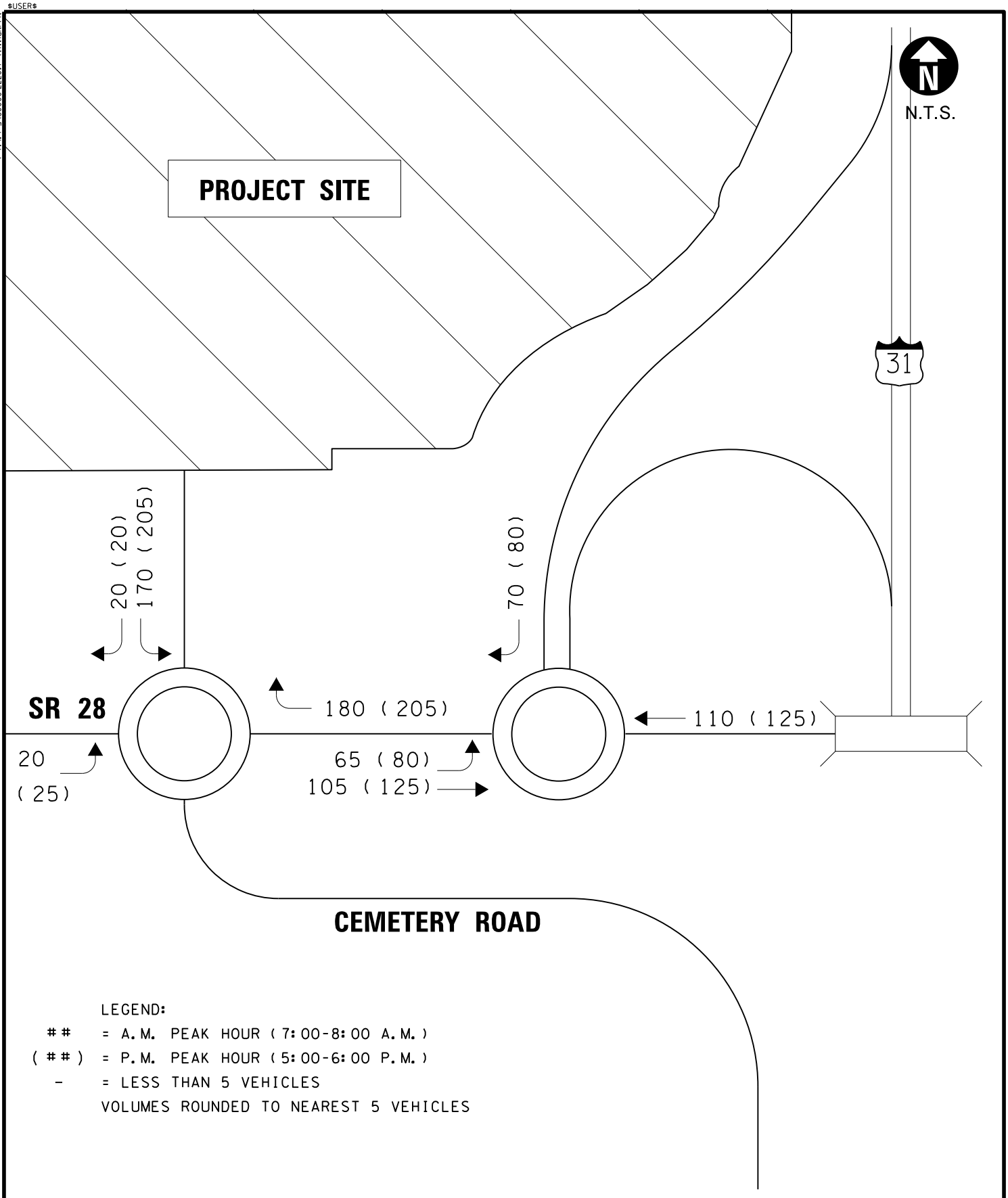

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-	= LESS THAN 5 VEHICLES

VOLUMES ROUNDED TO NEAREST 5 VEHICLES

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CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **2016 SITE GENERATED TRAFFIC VOLUMES FOR 1 YEAR DEVELOPMENT PLAN**

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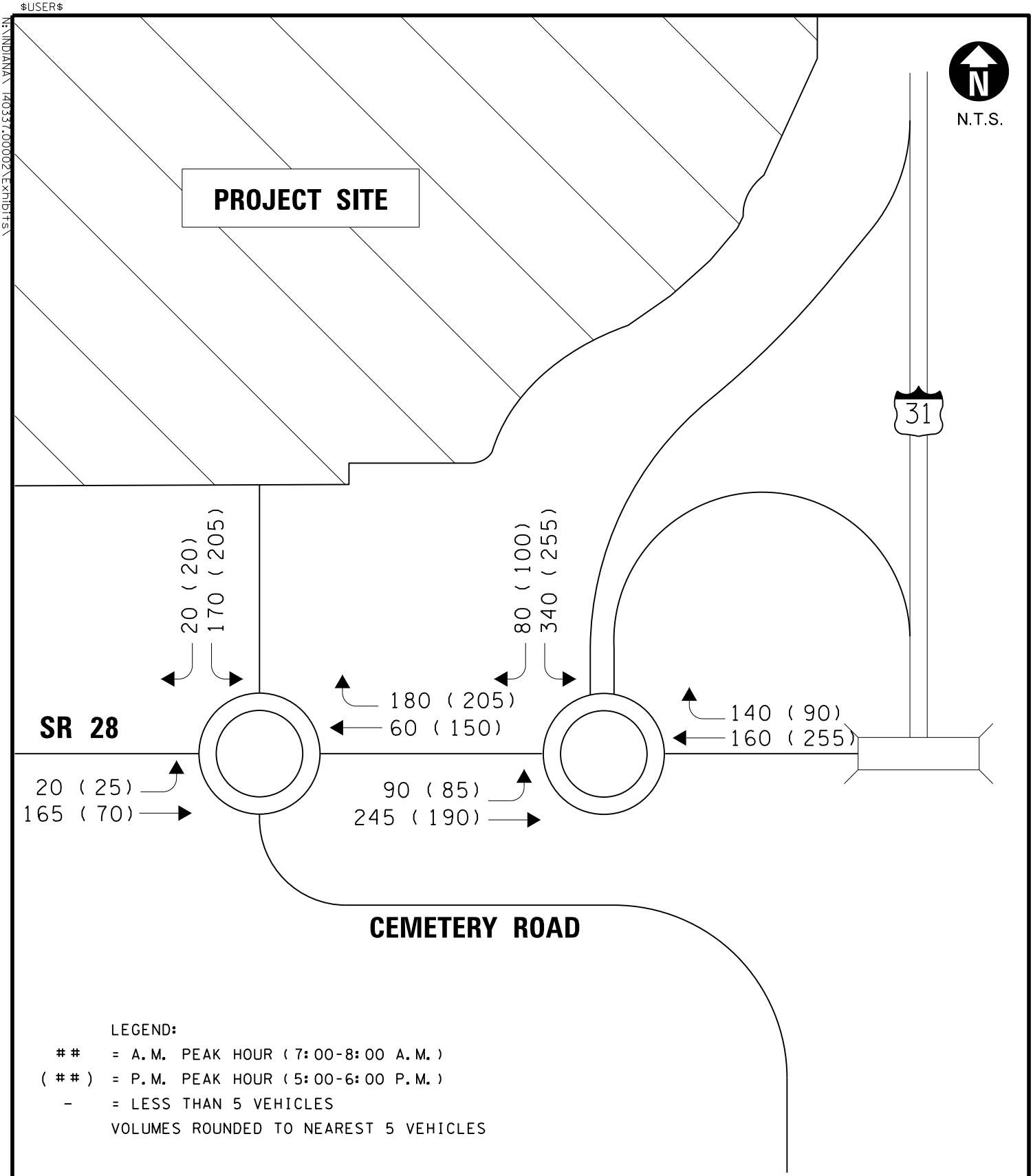

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\- = LESS THAN 5 VEHICLES

VOLUMES ROUNDED TO NEAREST 5 VEHICLES

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CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **TOTAL TRAFFIC**
ONE (1) YEAR (2016) DESIGN HORIZON

PROJECT NO. 140337.00002
DATE: 5-8-2015
SHEET NO. FIG-11

has estimated a background factor of 0.25% annual growth, which is representative of the growth expected in the region.

3.5 Total Traffic Assignment

The estimated site traffic volumes for the Love's development (Figure 10) were combined with the existing weekday peak hour traffic volumes (Figure 9) and the background growth traffic volumes to determine the total traffic assignment for each of the design horizons. The total traffic assignment volumes for the weekday morning and evening peak hours adjacent for Year of Construction are shown in Figure 11.

4.0 Five (5) Year Development Plan (Full Build-Out)

The following section describes the estimated trip ends generated by the proposed Five (5) Year Development plan and the procedures used to develop those estimates for the full build-out condition.

The estimates of traffic to be generated by the site are based upon the proposed land use type and size as shown in Figure 7. Traffic generation estimates for the proposed Five (5) Year development are determined using rates and fitted curve equations published in the ITE Report.

4.1 Site Generated Traffic

The rates and equations shown in Table 6 were used to estimate trips generated by the Five (5) Year Development plan. They reflect typical trip ends based on the rates in the ITE Report. Table 7 summarizes the number of vehicles anticipated to be generated at the site during full build-out condition. These volumes are based on the generation rates and the size (dependent variable) of each proposed land use.

Table 6: Trip Generation Rates

Land Use [ITE Land Use Code]	Daily (trips/day/unit)	AM Peak (trips/hour/unit)	PM Peak (trips/hour/unit)
Fast-Food Restaurant with Drive-Through Window [934] (Trips/1000 s.f.)	T = 496.12(X)	T = 45.42 (X)	T = 32.65(X)
Gasoline/Service Station with Convenience Market [945] (Trips/Fueling Stations)	T = 162.78(X)	T = 10.16(X)	T = 13.51(X)
Tire Store [848] (Trips/Service Bays)	No Equation Given	T = 2.1(X)	T = 3.54(X)
Hotel [310] (Trips/Rooms)	T = 8.95(X) – 373.16	T = 0.53 (X)	T = 0.60(X)
Free-Standing Discount Store [815] (Trips/1000 s.f.)	T = 57.24 (X)	T = 1.06 (X)	T = 4.98 (X)
Automobile Sales [841] (Trips/1000 s.f.)	T = 32.3 (X)	T = 1.92 (X)	T = 1.91 (X) + 23.74

s.f. = Square feet
X = Independent variable (i.e. 1000 s.f. of floor area)
T = Estimated trip ends; based on ITE Report Average Rate

Table 7: Love's Site with Five (5) Year Development Traffic Generation

	Building Number [ITE Land Use Code]	Size	Average Daily Trips	AM			PM		
				In	Out	Total	In	Out	Total
Love's Site	Fast Food Restaurant with Drive Through – [934]	2,800 s.f.	1,390	65	60	125	50	45	95
	Gas Station with Convenience Store– [945]	26 fuel stations	4,230	130	130	260	175	175	350
	Tire Store [848]	2 service bays		5	0	5	5	5	10
Five Year Development	Hotel – [310]	80 rooms	340	15	25	40	25	25	50
	Fast Food Restaurant with Drive Through – [934]	4,000 s.f.	1,980	95	90	185	70	65	135
	Fast Food Restaurant with Drive Through – [934]	4,000 s.f.	1,980	95	90	185	70	65	135
	Fast Food Restaurant with Drive Through – [934]	4,000 s.f.	1,980	95	90	185	70	65	135
	Free-Standing Discount Store – [815]	35,000 s.f.	2,000	25	10	35	85	85	170
	Automobile Sales – [841]	30,000 s.f.	970	45	15	60	30	50	80
	Free-Standing Discount Store – [815]	43,000 s.f.	2,460	30	15	45	105	105	210
	Total		**17,330**	**610**	**515**	**1,125**	**685**	**685**	**1,370**

It should be noted that this type of multi-use development site, which includes a gas station, convenience store, fast-food restaurants, hotel, automobile sales, and discount retail stores, generally experiences a significant amount of internal capture trips, which would reduce the total number of trips added to the roadway network. Similar to the One (1) Year Development plan, CBBEL has conducted this analysis on the basis of the full trip generation estimates from the ITE Report, which reflects the traffic expected if all the customers for each land use arrived at the site independently. By not deducting passer-by trips and internal trips, this will result in a more conservative analysis.

4.2 Trip Distribution

The same percent distribution of vehicles for the One (1) Year Development plan was applied to the Five (5) Year Development plan, which considers the site access location, land uses, congestion, nearby traffic generators, the area road network, and travel patterns of existing traffic. The estimated directional distribution for both the One (1) Year and Five (5) Year Development plans are shown in Table 8 and Figure 8.

Table 8: Directional Distribution

Roadway Segment	Percent of Site Generated Traffic
Indiana Route 28 East	20%
Indiana Route 28 West	10%
US Route 31 North	35%
US Route 31 South	35%
Total	**100%**

4.3 Site Traffic Assignment

The site traffic assignment for both the One (1) Year and Five (5) Year Development plans is based on the application of the directional distribution estimates (Table 8) to the site generated traffic volumes (Table 7). The site traffic assignment for the weekday morning and evening peak hours is shown in Figure 13.

4.4 Background Traffic Growth

CBBEL utilized background traffic volume growth rates provided by INDOT for traffic volumes on Indiana Route 28. Based on the data provided, CBBEL has estimated a background factor of 0.25% annual growth, which is representative of the growth expected in the region. The five year background traffic volumes are shown in Figure 12.

4.5 Total Traffic Assignment

The estimated site traffic volumes for the Love's site and Five Year Development plan (Figure 13) were combined with the background weekday peak hour traffic volumes (Figure 12) and the background growth traffic volumes to determine the total traffic assignment for the Five Year Design Horizon. The total traffic assignment volumes for the weekday morning and evening peak hours adjacent for the Five Year Horizon are shown in Figure 14.

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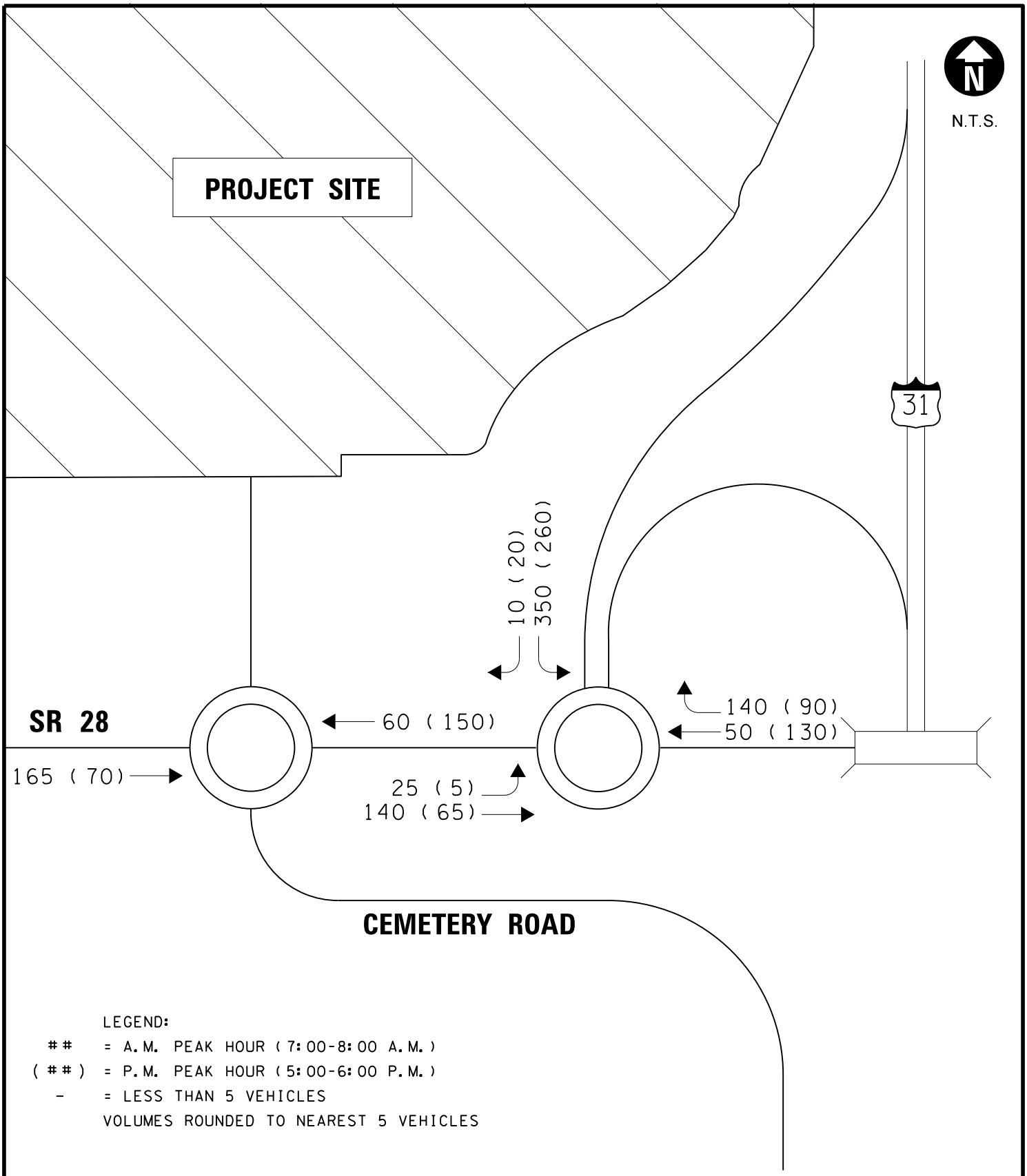

LEGEND:

##	= A.M. PEAK HOUR (7:00-8:00 A.M.)
(##)	= P.M. PEAK HOUR (5:00-6:00 P.M.)
-	= LESS THAN 5 VEHICLES

VOLUMES ROUNDED TO NEAREST 5 VEHICLES

CHRISTOPHER B. BURKE ENGINEERING, LLC
115 West Washington Street, Suite 1368 South
Indianapolis, Indiana 46204
(317) 266-8000

CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **FIVE (5) YEAR 2021 BACKGROUND TRAFFIC**

PROJECT NO. 140337.00002
DATE: 5-8-2015
SHEET NO. FIG-12

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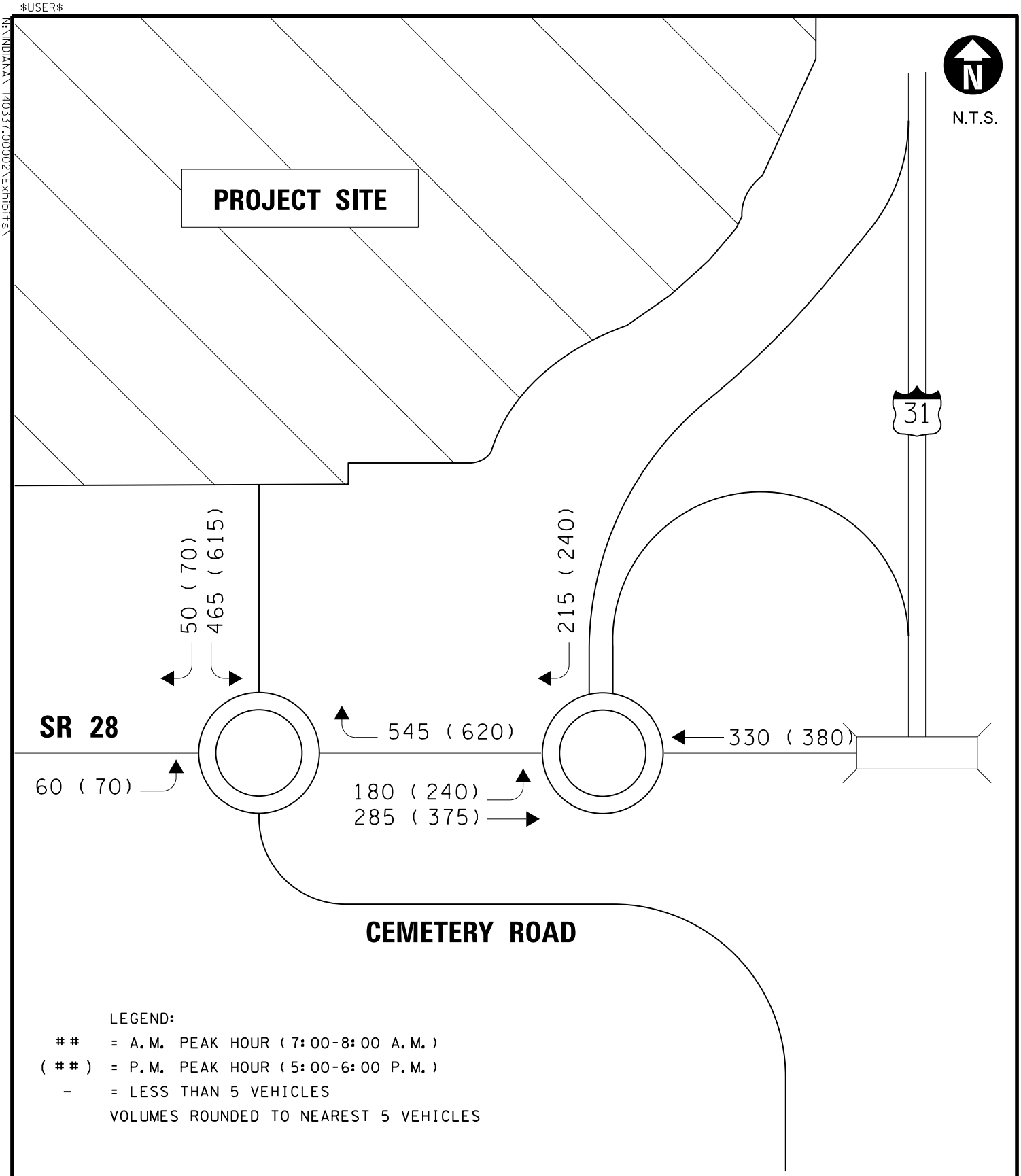

LEGEND:

= A.M. PEAK HOUR (7:00-8:00 A.M.)

(##) = P.M. PEAK HOUR (5:00-6:00 P.M.)

\- = LESS THAN 5 VEHICLES

VOLUMES ROUNDED TO NEAREST 5 VEHICLES

CHRISTOPHER B. BURKE ENGINEERING, LLC
115 West Washington Street, Suite 1368 South
Indianapolis, Indiana 46204
(317) 266-8000

CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **SITE GENERATED TRAFFIC**
5 YEAR DEVELOPMENT PLAN (2021)

PROJECT NO. 140337.00002
DATE: 5-8-2015
SHEET NO. FIG-13

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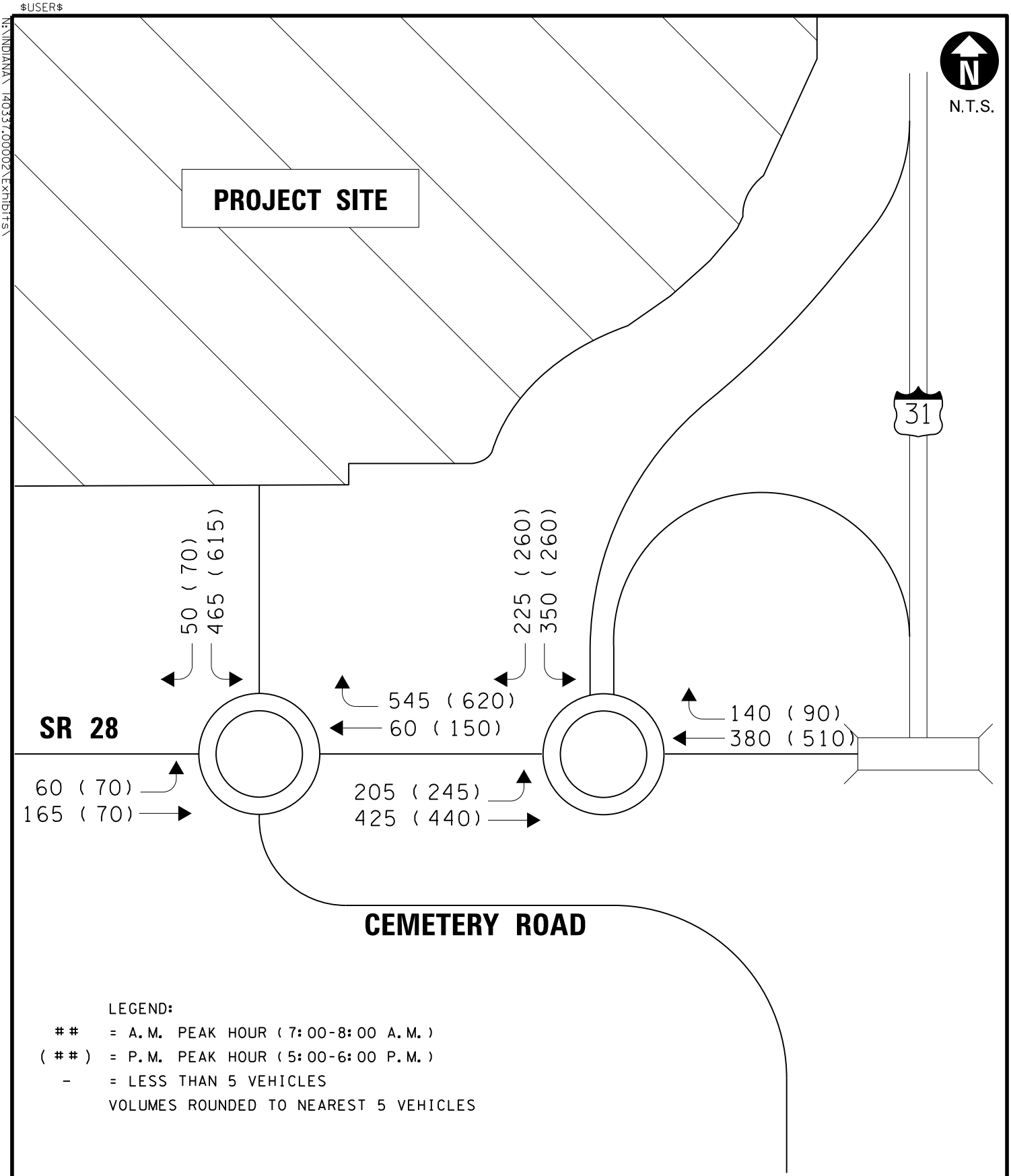

LEGEND:

= A.M. PEAK HOUR (7:00-8:00 A.M.)

(##) = P.M. PEAK HOUR (5:00-6:00 P.M.)

\- = LESS THAN 5 VEHICLES

VOLUMES ROUNDED TO NEAREST 5 VEHICLES

CHRISTOPHER B. BURKE ENGINEERING, LLC
115 West Washington Street, Suite 1368 South
Indianapolis, Indiana 46204
(317) 266-8000

CLIENT: **LOVE'S TRAVEL STOPS & COUNTRY STORES**

TITLE: **TOTAL TRAFFIC**
FIVE YEAR DEVELOPMENT PLAN (2021)

PROJECT NO. 140337.00002
DATE: 5-8-2015
SHEET NO. FIG-14

5.0 Warrant Analysis

CBBEL conducted a warrant analysis for traffic signals to confirm whether additional traffic control measures are necessary at the intersection of the site access drive and Indiana Route 28. The warrant analysis was conducted according to the procedures established in the Indiana Manual on Uniform Traffic Control Devices 2011 Edition (IMUTCD). The Warrant Analyses were conducted using TEAPAC software [Version 8.61-21] and the full output is included in the Appendix of this report.

5.1 Traffic Signal Warrants

The results of the Warrant Analyses indicate that the estimated traffic volumes in the One (1) Year Development plan will not satisfy traffic signal warrants, but the warrants will be met for the Five (5) Year Development plan at the intersection of the site access drive and Indiana Route 28. The Five (5) Year Development volumes met the following IMUTCD Warrants: Warrant 1, Eight-Hour Vehicular Volume; Warrant 2, Four-Hour Vehicular Volume; and Warrant 3, Peak Hour. Based on the volume projections, capacity analyses, and the warrant analysis, a traffic control improvement should be considered at the intersection.

6.0 Capacity Analysis

Capacity analyses were performed for the proposed site entrance and the west (southbound) ramp roundabout proposed by INDOT along Indiana Route 28 to estimate the intersection performance under the projected traffic conditions. The capacity analyses were conducted using the Synchro (Version 8) software package from Trafficware and use the Highway Capacity Manual 2010 edition equations.

The analyses generate a level-of-service (LOS) result for each movement or lane group. LOS describes the performance of the intersection and is determined based on delay (seconds per vehicle). LOS, which is a qualitative measure of intersection operation, ranges from LOS "A" to LOS "F," with LOS "A" being the best performance level for an intersection.

6.1 Baseline Capacity Analysis

The baseline condition analyzes the background traffic volumes within our study area for comparison with the capacity results of the One (1) Year and Five (5) Year Development plans. The geometry used for the baseline analysis was the INDOT proposed west (southbound) ramp roundabout. The results of the baseline condition analysis are summarized in Table 9.

Table 9: Baseline Capacity Analysis
Approach Delay (LOS)

Intersection	Control	Approach	Weekday Peak Hour	
			AM Peak Hour	PM Peak Hour
State Route 28 / US Route 31 SB Ramp	Roundabout	North	A – 7.0	A – 6.8
		East	A – 5.0	A – 5.2
		West	A – 7.2	A – 5.1
		Overall	**A – 6.5**	**A – 6.0**

Table 10: Roundabout Level of Service Criteria (2010 HCM)

Control Delay per Vehicle (s)	LOS by Volume to Capacity Ratio	
	≤1	>1
≤ 10	A	F
> 10 and ≤ 15	B	F
> 15 and ≤ 25	C	F
> 25 and ≤ 35	D	F
> 35 and ≤ 50	E	F
> 50	F	F

6.2 One Way Stop Control

The stop control analysis for the One (1) Year Development design horizon was conducted using the proposed roundabout interchange geometry and a two way stop controlled intersection at the site access drive on Indiana Route 28. The geometry at the site access drive used in the analysis consisted of a dedicated southbound left-turn lane and right-turn lane and auxiliary turn lanes on both the eastbound and westbound approaches on Indiana Route 28. The results of the stop controlled analyses for the One Year Development plan (Love's Site) condition are summarized in Table 11.

Table 11: One Way Strop Control Intersection Capacity Analysis
One (1) Year Design Horizon
Approach Delay (LOS)

Intersection	Control	Approach	One Year Development Weekday Peak Hour	
			AM Peak Hour	PM Peak Hour
State Route 28 / US Route 31 SB Ramp	Roundabout	North	A – 9.6	A – 9.8
		East	A – 6.8	A – 7.3
		West	B – 10.9	A – 8.2
		Overall	**A – 9.2**	**A – 8.5**
State Route 28 / Site Access	TWSC	North	B – 12.0	B – 12.8
		Overall	**A – 3.9**	**A – 4.5**

Table 12: TWSC Level of Service Criteria (2010 HCM)

Control Delay per Vehicle (s)	LOS by Volume to Capacity Ratio	
	≤1	>1
≤ 10	A	F
> 10 and ≤ 15	B	F
> 15 and ≤ 25	C	F
> 25 and ≤ 35	D	F
> 35 and ≤ 50	E	F
> 50	F	F

6.3 Signalized Capacity Analyses

The signalized analyses for the One (1) Year Development and the Five (5) Year Development design horizons were conducted based on the proposed roundabout interchange geometry and a signalized intersection at the site access drive on Indiana Route 28. The geometry at the site access drive used in the analyses consisted of a dedicated southbound left-turn lane and right-turn lane and auxiliary turn lanes on both the eastbound and westbound approaches on Indiana Route 28. The results of the signalized analyses for the One (1) Year Development and Five (5) Year Development conditions are summarized in Table 13.

**Table 13: Signalized Intersection Capacity Analysis
One (1) and Five (5) Year Design Horizons
Approach Delay (LOS)**

Intersection	Control	Approach	One Year Development Weekday Peak Hour		Five Year Development Weekday Peak Hour	
			AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
State Route 28 / US Route 31 SB Ramp	Roundabout	North	A – 9.6	A – 9.8	D – 27.3	D – 33.9
		East	A – 6.8	A – 7.3	B – 13.4	C – 19.1
		West	B – 10.9	A – 8.2	D – 31.9	D – 28.6
		Overall	**A – 9.2**	**A – 8.5**	**C – 24.8**	**D – 27.0**
State Route 28 / Site Access	Signalized	North	B – 18.6	B – 17.5	B – 18.5	B – 16.8
		East	A – 4.5	A – 5.7	A – 7.2	A – 9.7
		West	A – 4.3	A – 4.6	A – 9.3	B – 12.3
		Overall	**A – 8.5**	**A – 9.2**	**B – 11.6**	**B – 12.8**

Table 14: Signalized Intersection Level of Service Criteria (2010 HCM)

Control Delay per Vehicle (s)	LOS by Volume to Capacity Ratio	
	≤1	>1
≤ 10	A	F
> 10 and ≤ 20	B	F
> 20 and ≤ 35	C	F
> 35 and ≤ 55	D	F
> 55 and ≤ 80	E	F
> 80	F	F

6.4 Roundabout Capacity Analyses

The roundabout analyses for the One (1) Year Development and the Five (5) Year Development design horizons were conducted based on the proposed roundabout interchange geometry and an additional roundabout located at the site access drive on Indiana Route 28. The geometry used for the analysis was a single lane roundabout. The results of the roundabout analyses for the One (1) Year Development and Five (5) Year Development conditions are summarized in Table 15.

**Table 15: Roundabout Capacity Analysis
One (1) and Five (5) Year Design Horizons
Approach Delay (LOS)**

Intersection	Control	Approach	One Year Development Weekday Peak Hour		Five Year Development Weekday Peak Hour	
			AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
State Route 28 / US Route 31 SB Ramp	Roundabout	North	A – 9.6	A – 9.8	D – 27.3	D – 33.9
		East	A – 6.8	A – 7.3	B – 13.4	C – 19.1
		West	B – 10.9	A – 8.2	D – 31.9	D – 28.6
		Overall	**A – 9.2**	**A – 8.5**	**C – 24.8**	**D – 27.0**
State Route 28 / Site Access	Roundabout	North	A – 5.3	A – 6.3	A – 9.8	C – 18.8
		East	A – 5.5	A – 6.8	B – 11.8	C – 19.1
		West	A – 6.0	A – 5.1	A – 10.0	A – 9.7
		Overall	**A – 5.6**	**A – 6.4**	**B – 10.7**	**C – 18.2**

Table 16: Roundabout Level of Service Criteria (2010 HCM)

Control Delay per Vehicle (s)	LOS by Volume to Capacity Ratio	
	≤1	>1
≤ 10	A	F
> 10 and ≤ 15	B	F
> 15 and ≤ 25	C	F
> 25 and ≤ 35	D	F
> 35 and ≤ 50	E	F
> 50	F	F

7.0 Findings

The following is a summary of the capacity analysis results for the One (1) Year (Love's site) and Five (5) Year Development (full build-out) conditions.

One (1) Year Development Plan

The traffic generated from the One (1) Year Development condition maybe managed with a One Way Stop Control, Signalized Control or Roundabout. The One Way Stop Control alternative resulted in the lowest delay per vehicle for the proposed site access drive intersection at the 1 year design horizon.

The One (1) Year Development right turn volume does meet the threshold value for an auxiliary right turn lane on the east approach of Indiana Route 28, according to the INDOT Design Manual Chapter 46 using the unsignalized intersection guidance (Figure 46-4A).

Five (5) Year Development Plan

The traffic generated from the Five (5) Year Development condition maybe managed with Signalized Control or a Roundabout. The Signalized Control and Roundabout conditions yielded similar vehicle delay for both peak periods.

The capacity analyses indicate that the existing west (southbound) ramp roundabout intersection will operate at acceptable levels-of-service with the projected traffic for the One (1) Year Development (Love's site). The capacity analyses for the Five (5) Year Development plan do show an increase in delay, but operate below capacity.

8.0 Conclusions and Recommendations

The planned facilities at the project site are expected to result in traffic volumes that will require improvements to the intersection of Indiana Route 28 at the proposed site access drive.

Conclusions

For the Five (5) Year Development plan, a roundabout alternative is recommended because of the proximity of the adjacent roundabout interchange and to meet driver expectation.

One (1) Year Development Plan Recommended Improvements

The recommended roadway improvements for the One (1) Year Development plan consist of the following:

- Installation of One Way Stop Control for the site access drive
- Installation of an auxiliary right turn lane for the east approach of Indiana Route 28
- Monitor traffic volumes as the site develops to evaluate the need for a traffic signal in the future as an interim improvement.

Five (5) Year Development Plan Recommended Improvements

The recommended roadway improvements for the Five (5) Year Development plan consist of the following:

- Installation of a Roundabout at the site access drive

Appendix

Traffic Count Data

Fish Transportation Group

801 South Blvd, Suite 5
Oak Park, IL 60302

Tipton, Indiana
IN 28
East of US 31

Date Start: 26-Mar-15
Date End: 26-Mar-15

Start Time	26-Mar-15 Thu	EB	WB	Combined Total
12:00 AM		10	27	37
01:00		22	8	30
02:00		17	9	26
03:00		28	12	40
04:00		31	43	74
05:00		300	242	542
06:00		149	177	326
07:00		264	215	479
08:00		158	168	326
09:00		145	139	284
10:00		127	157	284
11:00		169	154	323
12:00 PM		186	161	347
01:00		169	135	304
02:00		177	186	363
03:00		175	261	436
04:00		251	467	718
05:00		311	231	542
06:00		228	142	370
07:00		120	110	230
08:00		75	77	152
09:00		72	60	132
10:00		46	68	114
11:00		27	29	56
Total		3257	3278	6535
Percent		49.8%	50.2%	

Fish Transportation Group

801 South Blvd, Suite 5
Oak Park, IL 60302

Tipton, Indiana
IN 28
West of US 31

Date Start: 26-Mar-15
Date End: 26-Mar-15

Start Time	26-Mar-15 Thu	EB	WB	Combined Total
12:00 AM		7	12	19
01:00		12	9	21
02:00		14	3	17
03:00		13	5	18
04:00		29	27	56
05:00		54	34	88
06:00		87	56	143
07:00		148	78	226
08:00		93	63	156
09:00		72	70	142
10:00		79	79	158
11:00		65	61	126
12:00 PM		87	85	172
01:00		74	86	160
02:00		86	110	196
03:00		85	137	222
04:00		126	130	256
05:00		128	130	258
06:00		88	95	183
07:00		45	73	118
08:00		32	64	96
09:00		37	45	82
10:00		15	35	50
11:00		19	19	38
Total		1495	1506	3001
Percent		49.8%	50.2%	

Traffic Control Warrant Analyses

Traffic Signal Analysis

TEAPAC[Ver 8.62.01] - MUTCD Warrant Analysis

Conditions Used for Warrant Analysis	2011 IMUTCD
Intersection # 1	
Major Street Direction	EastWest
Number of Lanes in North-South direction	2
Number of Lanes in East-West direction	2
Approach speed on major street is greater than 40 mph	No
Isolated community has population less than 10,000	Yes
Signal will not seriously disrupt progressive traffic flow	Yes
Trials of other remedies have failed to improve conditions	Yes
Number of accidents correctable by a signal	0
Peak hour stop sign delay for worst minor approach (veh-hours)	1
Number of accidents correctable by a multi-way stop	0
Peak hour average delay for all minor approaches (sec/veh)	10

TEAPAC[Ver 8.62.01] - Warrant Analysis for Traffic Signal

Warrant 1A Analysis - 8-Hour Minimum Vehicular Volume

Start Time	1600	1700	700	1500	1400	1800	1200	800	Req.
Minor Volume	225	225	190	190	170	160	150	135	150
Major Volume	450	450	425	385	345	320	360	275	500
Warrant Met?	No	No	No	No	No	No	No	No	8

Number of 1-hour periods meeting the warrant	0
Signal will not seriously disrupt progressive traffic flow	Yes

>> WARRANT 1A IS NOT MET <<

Warrant 1B Analysis - 8-Hour Interruption of Continuous Traffic

Start Time	1600	1700	700	1500	1400	1800	1200	800	Req.
Minor Volume	225	225	190	190	170	160	150	135	75
Major Volume	450	450	425	385	345	320	360	275	750
Warrant Met?	No	No	No	No	No	No	No	No	8

Number of 1-hour periods meeting the warrant	0
Signal will not seriously disrupt progressive traffic flow	Yes

>> WARRANT 1B IS NOT MET <<

TEAPAC[Ver 8.62.01] - Warrant Analysis for Traffic Signal

Warrant 1A Analysis (80%) - 8-Hour Minimum Vehicular Volume

Start Time	1600	1700	700	1500	1400	1200	1800	800	Req.
Minor Volume	225	225	190	190	170	150	160	135	120
Major Volume	450	450	425	385	345	360	320	275	400
Warrant Met?	Yes	Yes	Yes	No	No	No	No	No	8

Number of 1-hour periods meeting the warrant (56% allowed) 3

Warrant 1B Analysis (80%) - 8-Hour Interruption of Continuous Traf

Start Time	1600	1700	700	1500	1400	1800	1200	800	Req.
Minor Volume	225	225	190	190	170	160	150	135	60
Major Volume	450	450	425	385	345	320	360	275	600
Warrant Met?	No	No	No	No	No	No	No	No	8

Number of 1-hour periods meeting the warrant (56% allowed) 0

Warrant 1C Analysis - 8-Hour Combination of Warrants

80% of Warrants 1A and 1B are met (56% allowed) No
Signal will not seriously disrupt progressive traffic flow Yes
Trials of other remedies have failed to reduce delays Yes

>> WARRANT 1C IS NOT MET <<

Warrant 2 Analysis - 4-Hour Vehicular Volume

Start Time	1600	1700	700	1500	1400	1800	1200	800	Req.
Minor Volume	225	225	190	190	170	160	150	135	———
Minor Reqrmt	285	285	297	317	338	352	330	376	<--
Warrant Met?	No	No	No	No	No	No	No	No	4

Number of 1-hour periods meeting the warrant 0
Signal will not seriously disrupt progressive traffic flow Yes

>> WARRANT 2 IS NOT MET <<

TEAPAC[Ver 8.62.01] - Warrant Analysis for Traffic Signal

Warrant 3A Analysis - Peak Hour Delay

Start Time	1600	1700	700	1500	1400	1800	1200	800	Req.
Minor Volume	225	225	190	190	170	160	150	135	150
Total Volume	675	675	615	575	515	480	510	410	650
Warrant Met?	Yes	Yes	No	No	No	No	No	No	1

Number of 1-hour periods meeting the warrant	2
Signal will not seriously disrupt progressive traffic flow	Yes
Delay for worst minor approach (must be at least 5 veh-hours)	1

>> WARRANT 3A IS NOT MET <<

Warrant 3B Analysis - Peak Hour Volume

Start Time	1600	1700	700	1500	1400	1800	1200	800	Req.
Minor Volume	225	225	190	190	170	160	150	135	———
Minor Reqrmt	450	450	464	487	511	526	502	554	<--
Warrant Met?	No	No	No	No	No	No	No	No	1

Number of 1-hour periods meeting the warrant	0
Signal will not seriously disrupt progressive traffic flow	Yes

>> WARRANT 3B IS NOT MET <<

Summary of MUTCD Traffic Signal Warrant Analysis

Warrant 1A 8-Hour Minimum Vehicular Volume	NOT MET
Warrant 1B 8-Hour Interruption of Continuous Traffic	NOT MET
Warrant 1C 8-Hour Combination of Warrants	NOT MET
Warrant 2 4-Hour Vehicular Volume	NOT MET
Warrant 3A Peak Hour Delay	NOT MET
Warrant 3B Peak Hour Volume	NOT MET

>> Traffic Signal Warrant is NOT MET <<

TEAPAC[Ver 8.62.01] - 60-Minute Volumes: by Movement

Int# 1

Begin Time	N-Approach RT	N-Approach TH	N-Approach LT	E-Approach RT	E-Approach TH	E-Approach LT	S-Approach RT	S-Approach TH	S-Approach LT	W-Approach RT	W-Approach TH	W-Approach LT	Int Total
600	10	0	115	115	35	0	0	0	0	0	90	15	380*
700	20	0	170	180	60	0	0	0	0	0	165	20	615*
800	10	0	125	125	35	0	0	0	0	0	100	15	410*
900	10	0	110	110	35	0	0	0	0	0	90	15	370*
1000	10	0	125	125	35	0	0	0	0	0	100	15	410*
1100	10	0	100	100	75	0	0	0	0	0	80	10	375*
1200	15	0	135	135	100	0	0	0	0	0	110	15	510*
1300	10	0	125	125	90	0	0	0	0	0	45	15	410*
1400	15	0	155	155	115	0	0	0	0	0	55	20	515*
1500	15	0	175	175	130	0	0	0	0	0	60	20	575*
1600	20	0	205	205	150	0	0	0	0	0	70	25	675*
1700	20	0	205	205	150	0	0	0	0	0	70	25	675*
1800	15	0	145	145	105	0	0	0	0	0	50	20	480*

TEAPAC[Ver 8.62.01] - 60-Minute Volumes: Appr/Exit Totals

Int# 1

Begin Time	Approach Totals N	Approach Totals E	Approach Totals S	Approach Totals W	Exit Totals N	Exit Totals E	Exit Totals S	Exit Totals W	Int Total
600	125	150	0	105	130	205	0	45	380*
700	190	240	0	185	200	335	0	80	615*
800	135	160	0	115	140	225	0	45	410*
900	120	145	0	105	125	200	0	45	370*
1000	135	160	0	115	140	225	0	45	410*
1100	110	175	0	90	110	180	0	85	375*
1200	150	235	0	125	150	245	0	115	510*
1300	135	215	0	60	140	170	0	100	410*
1400	170	270	0	75	175	210	0	130	515*
1500	190	305	0	80	195	235	0	145	575*
1600	225	355	0	95	230	275	0	170	675*
1700	225	355	0	95	230	275	0	170	675*
1800	160	250	0	70	165	195	0	120	480*

TEAPAC[Ver 8.62.01] - MUTCD Warrant Analysis

Conditions Used for Warrant Analysis	2011 IMUTCD
Intersection # 1	
Major Street Direction	EastWest
Number of Lanes in North-South direction	2
Number of Lanes in East-West direction	2
Approach speed on major street is greater than 40 mph	No
Isolated community has population less than 10,000	Yes
Signal will not seriously disrupt progressive traffic flow	Yes
Trials of other remedies have failed to improve conditions	Yes
Number of accidents correctable by a signal	0
Peak hour stop sign delay for worst minor approach (veh-hours)	13
Number of accidents correctable by a multi-way stop	0
Peak hour average delay for all minor approaches (sec/veh)	68

TEAPAC[Ver 8.62.01] - Warrant Analysis for Traffic Signal

Warrant 1A Analysis - 8-Hour Minimum Vehicular Volume

Start Time	1700	1600	1500	1400	700	1800	1200	1000	Req.
Minor Volume	685	680	590	520	515	485	455	425	150
Major Volume	910	905	785	695	830	645	665	560	500
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8

Number of 1-hour periods meeting the warrant	12
Signal will not seriously disrupt progressive traffic flow	Yes

>> WARRANT 1A IS MET <<

Warrant 1B Analysis - 8-Hour Interruption of Continuous Traffic

Start Time	1700	1600	1500	1400	700	1800	1200	1000	Req.
Minor Volume	685	680	590	520	515	485	455	425	75
Major Volume	910	905	785	695	830	645	665	560	750
Warrant Met?	Yes	Yes	Yes	No	Yes	No	No	No	8

Number of 1-hour periods meeting the warrant	4
Signal will not seriously disrupt progressive traffic flow	Yes

>> WARRANT 1B IS NOT MET <<

TEAPAC[Ver 8.62.01] - Warrant Analysis for Traffic Signal

Warrant 1A Analysis (80%) - 8-Hour Minimum Vehicular Volume

Start Time	1700	1600	1500	1400	700	1800	1200	1000	Req.
Minor Volume	685	680	590	520	515	485	455	425	120
Major Volume	910	905	785	695	830	645	665	560	400
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8

Number of 1-hour periods meeting the warrant (56% allowed) 13

Warrant 1B Analysis (80%) - 8-Hour Interruption of Continuous Traf

Start Time	1700	1600	1500	1400	700	1800	1200	1000	Req.
Minor Volume	685	680	590	520	515	485	455	425	60
Major Volume	910	905	785	695	830	645	665	560	600
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	8

Number of 1-hour periods meeting the warrant (56% allowed) 7

Warrant 1C Analysis - 8-Hour Combination of Warrants

80% of Warrants 1A and 1B are met (56% allowed)	No
Signal will not seriously disrupt progressive traffic flow	Yes
Trials of other remedies have failed to reduce delays	Yes

>> WARRANT 1C IS NOT MET <<

Warrant 2 Analysis - 4-Hour Vehicular Volume

Start Time	1700	1600	1500	1400	700	1800	1200	1000	Req.
Minor Volume	685	680	590	520	515	485	455	425	———
Minor Reqrmt	117	119	153	183	139	201	194	236	<--
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4

Number of 1-hour periods meeting the warrant	13
Signal will not seriously disrupt progressive traffic flow	Yes

>> WARRANT 2 IS MET <<

TEAPAC[Ver 8.62.01] - Warrant Analysis for Traffic Signal

Warrant 3A Analysis - Peak Hour Delay

Start Time	1700	1600	1500	1400	700	1800	1200	1000	Req.
Minor Volume	685	680	590	520	515	485	455	425	150
Total Volume	1595	1585	1375	1215	1345	1130	1120	985	650
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	1

Number of 1-hour periods meeting the warrant	13
Signal will not seriously disrupt progressive traffic flow	Yes
Delay for worst minor approach (must be at least 5 veh-hours)	13

>> WARRANT 3A IS MET <<

Warrant 3B Analysis - Peak Hour Volume

Start Time	1700	1600	1500	1400	700	1800	1200	1000	Req.
Minor Volume	685	680	590	520	515	485	455	425	———
Minor Reqrmt	238	240	287	326	269	349	340	391	<--
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	1

Number of 1-hour periods meeting the warrant	11
Signal will not seriously disrupt progressive traffic flow	Yes

>> WARRANT 3B IS MET <<

Summary of MUTCD Traffic Signal Warrant Analysis

Warrant 1A 8-Hour Minimum Vehicular Volume	MET
Warrant 1B 8-Hour Interruption of Continuous Traffic	NOT MET
Warrant 1C 8-Hour Combination of Warrant	NOT MET
Warrant 2 4-Hour Vehicular Volume	MET
Warrant 3A Peak Hour Delay	MET
Warrant 3B Peak Hour Volume	MET

>> Traffic Signal Warrant is MET <<

TEAPAC[Ver 8.62.01] - 60-Minute Volumes: by Movement

Int# 1

Begin Time	N-Approach RT	N-Approach TH	N-Approach LT	E-Approach RT	E-Approach TH	E-Approach LT	S-Approach RT	S-Approach TH	S-Approach LT	W-Approach RT	W-Approach TH	W-Approach LT	Int Total
600	40	0	345	345	35	0	0	0	0	0	90	40	895*
700	50	0	465	545	60	0	0	0	0	0	165	60	1345*
800	40	0	370	375	35	0	0	0	0	0	100	40	960*
900	40	0	335	340	35	0	0	0	0	0	90	40	880*
1000	45	0	380	380	35	0	0	0	0	0	100	45	985*
1100	35	0	300	305	75	0	0	0	0	0	80	35	830*
1200	45	0	410	410	100	0	0	0	0	0	110	45	1120*
1300	45	0	380	380	90	0	0	0	0	0	45	45	985*
1400	55	0	465	470	115	0	0	0	0	0	55	55	1215*
1500	60	0	530	535	130	0	0	0	0	0	60	60	1375*
1600	70	0	610	615	150	0	0	0	0	0	70	70	1585*
1700	70	0	615	620	150	0	0	0	0	0	70	70	1595*
1800	50	0	435	440	105	0	0	0	0	0	50	50	1130*

TEAPAC[Ver 8.62.01] - 60-Minute Volumes: Appr/Exit Totals

Int# 1

Begin Time	Approach Totals N	Approach Totals E	Approach Totals S	Approach Totals W	Exit Totals N	Exit Totals E	Exit Totals S	Exit Totals W	Int Total
600	385	380	0	130	385	435	0	75	895*
700	515	605	0	225	605	630	0	110	1345*
800	410	410	0	140	415	470	0	75	960*
900	375	375	0	130	380	425	0	75	880*
1000	425	415	0	145	425	480	0	80	985*
1100	335	380	0	115	340	380	0	110	830*
1200	455	510	0	155	455	520	0	145	1120*
1300	425	470	0	90	425	425	0	135	985*
1400	520	585	0	110	525	520	0	170	1215*
1500	590	665	0	120	595	590	0	190	1375*
1600	680	765	0	140	685	680	0	220	1585*
1700	685	770	0	140	690	685	0	220	1595*
1800	485	545	0	100	490	485	0	155	1130*

Baseline Intersection Capacity Analyses

Roundabout

Intersection	
Intersection Delay, s/veh	6.5
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	173	200	369
Demand Flow Rate, veh/h	177	204	376
Vehicles Circulating, veh/h	365	27	54
Vehicles Exiting, veh/h	65	515	177
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.2	5.0	7.0
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	177	204	376
Cap Entry Lane, veh/h	784	1100	1071
Entry HV Adj Factor	0.978	0.980	0.981
Flow Entry, veh/h	173	200	369
Cap Entry, veh/h	767	1078	1051
V/C Ratio	0.226	0.185	0.351
Control Delay, s/veh	7.2	5.0	7.0
LOS	A	A	A
95th %tile Queue, veh	1	1	2

Intersection	
Intersection Delay, s/veh	6.0
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	73	232	289
Demand Flow Rate, veh/h	74	237	294
Vehicles Circulating, veh/h	273	5	140
Vehicles Exiting, veh/h	161	342	102
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.1	5.2	6.8
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	74	237	294
Cap Entry Lane, veh/h	860	1124	982
Entry HV Adj Factor	0.982	0.980	0.983
Flow Entry, veh/h	73	232	289
Cap Entry, veh/h	844	1102	966
V/C Ratio	0.086	0.211	0.299
Control Delay, s/veh	5.1	5.2	6.8
LOS	A	A	A
95th %tile Queue, veh	0	1	1

One (1) Year Development Capacity Results

Two Way Stop Control
Signalized Intersection
Roundabout

Intersection	
Intersection Delay, s/veh	9.2
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	353	315	442
Demand Flow Rate, veh/h	360	321	451
Vehicles Circulating, veh/h	365	97	171
Vehicles Exiting, veh/h	257	628	247
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.9	6.8	9.6
Approach LOS	B	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	360	321	451
Cap Entry Lane, veh/h	784	1025	952
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	353	315	442
Cap Entry, veh/h	769	1005	933
V/C Ratio	0.459	0.313	0.474
Control Delay, s/veh	10.9	6.8	9.6
LOS	B	A	A
95th %tile Queue, veh	2	1	3

Intersection	
Int Delay, s/veh	3.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	20	165	0	0	60	180	0	0	0	170	0	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	185	-	-	-	-	185	-	-	-	0	-	0
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	174	0	0	63	189	0	0	0	179	0	21

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	63	0	0	174	0	0	279	279	174	279	279	63
Stage 1	-	-	-	-	-	-	216	216	-	63	63	-
Stage 2	-	-	-	-	-	-	63	63	-	216	216	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1540	-	-	1403	-	-	673	629	869	673	629	1002
Stage 1	-	-	-	-	-	-	786	724	-	948	842	-
Stage 2	-	-	-	-	-	-	948	842	-	786	724	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1540	-	-	1403	-	-	652	620	869	666	620	1002
Mov Cap-2 Maneuver	-	-	-	-	-	-	652	620	-	666	620	-
Stage 1	-	-	-	-	-	-	775	714	-	935	842	-
Stage 2	-	-	-	-	-	-	928	842	-	775	714	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.8	0	0	12
HCM LOS			A	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	-	1540	-	-	1403	-	-	666	1002
HCM Lane V/C Ratio	-	0.014	-	-	-	-	-	0.269	0.021
HCM Control Delay (s)	0	7.4	-	-	0	-	-	12.4	8.7
HCM Lane LOS	A	A	-	-	A	-	-	B	A
HCM 95th %tile Q(veh)	-	0	-	-	0	-	-	1.1	0.1

Intersection	
Intersection Delay, s/veh	8.5
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	289	363	373
Demand Flow Rate, veh/h	295	370	380
Vehicles Circulating, veh/h	273	91	273
Vehicles Exiting, veh/h	380	477	188
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.2	7.3	9.8
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	295	370	380
Cap Entry Lane, veh/h	860	1032	860
Entry HV Adj Factor	0.980	0.980	0.982
Flow Entry, veh/h	289	363	373
Cap Entry, veh/h	843	1011	844
V/C Ratio	0.343	0.359	0.442
Control Delay, s/veh	8.2	7.3	9.8
LOS	A	A	A
95th %tile Queue, veh	2	2	2

Intersection	
Int Delay, s/veh	4.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	25	70	0	0	150	205	0	0	0	205	0	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	185	-	-	-	-	185	-	-	-	0	-	0
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	26	74	0	0	158	216	0	0	0	216	0	21

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	158	0	0	74	0	0	284	284	74	284	284	158
Stage 1	-	-	-	-	-	-	126	126	-	158	158	-
Stage 2	-	-	-	-	-	-	158	158	-	126	126	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1422	-	-	1526	-	-	668	625	988	668	625	887
Stage 1	-	-	-	-	-	-	878	792	-	844	767	-
Stage 2	-	-	-	-	-	-	844	767	-	878	792	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1422	-	-	1526	-	-	643	614	988	659	614	887
Mov Cap-2 Maneuver	-	-	-	-	-	-	643	614	-	659	614	-
Stage 1	-	-	-	-	-	-	862	778	-	829	767	-
Stage 2	-	-	-	-	-	-	824	767	-	862	778	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	2	0	0	12.8
HCM LOS			A	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	-	1422	-	-	1526	-	-	659	887
HCM Lane V/C Ratio	-	0.019	-	-	-	-	-	0.327	0.024
HCM Control Delay (s)	0	7.6	-	-	0	-	-	13.1	9.2
HCM Lane LOS	A	A	-	-	A	-	-	B	A
HCM 95th %tile Q(veh)	-	0.1	-	-	0	-	-	1.4	0.1

Intersection	
Intersection Delay, s/veh	9.2
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	353	315	442
Demand Flow Rate, veh/h	360	321	451
Vehicles Circulating, veh/h	365	97	171
Vehicles Exiting, veh/h	257	628	247
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.9	6.8	9.6
Approach LOS	B	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	360	321	451
Cap Entry Lane, veh/h	784	1025	952
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	353	315	442
Cap Entry, veh/h	769	1005	933
V/C Ratio	0.459	0.313	0.474
Control Delay, s/veh	10.9	6.8	9.6
LOS	B	A	A
95th %tile Queue, veh	2	1	3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	20	165	0	0	60	180	0	0	0	170	0	20
Number	5	2	12	1	6	16	3	8	18	7	4	14
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	1863	1863	1900	1900	1863	1863	1900	1863	1900	1863	0	1863
Adj Flow Rate, veh/h	21	174	0	0	63	189	0	0	0	179	0	21
Adj No. of Lanes	1	1	0	0	1	1	0	1	0	1	0	1
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	0	2
Cap, veh/h	729	1094	0	0	902	974	0	4	0	401	0	0
Arrive On Green	0.02	0.59	0.00	0.00	0.48	0.48	0.00	0.00	0.00	0.13	0.00	0.00
Sat Flow, veh/h	1774	1863	0	0	1863	1583	0	-111765	0	1774	179	
Grp Volume(v), veh/h	21	174	0	0	63	189	0	0	0	179	18.6	
Grp Sat Flow(s),veh/h/ln	1774	1863	0	0	1863	1583	0	1863	0	1774	B	
Q Serve(g_s), s	0.2	1.8	0.0	0.0	0.8	2.2	0.0	0.0	0.0	4.1		
Cycle Q Clear(g_c), s	0.2	1.8	0.0	0.0	0.8	2.2	0.0	0.0	0.0	4.1		
Prop In Lane	1.00		0.00	0.00		1.00	0.00		0.00	1.00		
Lane Grp Cap(c), veh/h	729	1094	0	0	902	974	0	4	0	401		
V/C Ratio(X)	0.03	0.16	0.00	0.00	0.07	0.19	0.00	0.00	0.00	0.45		
Avail Cap(c_a), veh/h	964	1094	0	0	902	974	0	263	0	627		
HCM Platoon Ratio	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	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00		
Uniform Delay (d), s/veh	4.4	4.0	0.0	0.0	5.9	3.6	0.0	0.0	0.0	17.8		
Incr Delay (d2), s/veh	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.8		
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		
%ile BackOfQ(95%),veh/ln	0.2	1.8	0.0	0.0	0.8	2.0	0.0	0.0	0.0	3.7		
LnGrp Delay(d),s/veh	4.4	4.3	0.0	0.0	6.0	4.0	0.0	0.0	0.0	18.6		
LnGrp LOS	A	A			A	A				B		
Approach Vol, veh/h		195			252			0				
Approach Delay, s/veh		4.3			4.5			0.0				
Approach LOS		A			A							

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2			5	6	7	8
Phs Duration (G+Y+Rc), s		31.0			4.4	26.6	11.6	0.0
Change Period (Y+Rc), s		6.0			3.5	6.0	6.0	6.0
Max Green Setting (Gmax), s		25.0			6.5	15.0	11.0	6.0
Max Q Clear Time (g_c+I1), s		3.8			2.2	4.2	6.1	0.0
Green Ext Time (p_c), s		1.7			0.0	1.4	0.2	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	8.5
HCM 2010 LOS	A

Intersection	
Intersection Delay, s/veh	8.5
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	289	363	373
Demand Flow Rate, veh/h	295	370	380
Vehicles Circulating, veh/h	273	91	273
Vehicles Exiting, veh/h	380	477	188
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.2	7.3	9.8
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	295	370	380
Cap Entry Lane, veh/h	860	1032	860
Entry HV Adj Factor	0.980	0.980	0.982
Flow Entry, veh/h	289	363	373
Cap Entry, veh/h	843	1011	844
V/C Ratio	0.343	0.359	0.442
Control Delay, s/veh	8.2	7.3	9.8
LOS	A	A	A
95th %tile Queue, veh	2	2	2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	25	70	0	0	150	205	0	0	0	205	0	20
Number	5	2	12	1	6	16	3	8	18	7	4	14
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	1863	1863	1900	1900	1863	1863	1900	1863	1900	1863	0	1863
Adj Flow Rate, veh/h	26	74	0	0	158	216	0	0	0	216	0	21
Adj No. of Lanes	1	1	0	0	1	1	0	1	0	1	0	1
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	0	2
Cap, veh/h	612	1031	0	0	828	953	0	4	0	453	0	0
Arrive On Green	0.02	0.55	0.00	0.00	0.44	0.44	0.00	0.00	0.00	0.16	0.00	0.00
Sat Flow, veh/h	1774	1863	0	0	1863	1583	0	-111765	0	1774	216	
Grp Volume(v), veh/h	26	74	0	0	158	216	0	0	0	216	17.5	
Grp Sat Flow(s),veh/h/ln	1774	1863	0	0	1863	1583	0	1863	0	1774	B	
Q Serve(g_s), s	0.3	0.8	0.0	0.0	2.1	2.6	0.0	0.0	0.0	4.8		
Cycle Q Clear(g_c), s	0.3	0.8	0.0	0.0	2.1	2.6	0.0	0.0	0.0	4.8		
Prop In Lane	1.00		0.00	0.00		1.00	0.00		0.00	1.00		
Lane Grp Cap(c), veh/h	612	1031	0	0	828	953	0	4	0	453		
V/C Ratio(X)	0.04	0.07	0.00	0.00	0.19	0.23	0.00	0.00	0.00	0.48		
Avail Cap(c_a), veh/h	845	1031	0	0	828	953	0	269	0	728		
HCM Platoon Ratio	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	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00		
Uniform Delay (d), s/veh	5.1	4.3	0.0	0.0	7.0	3.8	0.0	0.0	0.0	16.7		
Incr Delay (d2), s/veh	0.0	0.1	0.0	0.0	0.5	0.6	0.0	0.0	0.0	0.8		
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		
%ile BackOfQ(95%),veh/ln	0.3	0.8	0.0	0.0	2.2	2.3	0.0	0.0	0.0	4.3		
LnGrp Delay(d),s/veh	5.2	4.4	0.0	0.0	7.5	4.4	0.0	0.0	0.0	17.5		
LnGrp LOS	A	A			A	A				B		
Approach Vol, veh/h		100			374			0				
Approach Delay, s/veh		4.6			5.7			0.0				
Approach LOS		A			A							

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2			5	6	7	8
Phs Duration (G+Y+Rc), s		29.0			4.5	24.5	12.6	0.0
Change Period (Y+Rc), s		6.0			3.5	6.0	6.0	6.0
Max Green Setting (Gmax), s		23.0			6.5	13.0	13.0	6.0
Max Q Clear Time (g_c+I1), s		2.8			2.3	4.6	6.8	0.0
Green Ext Time (p_c), s		1.8			0.0	1.2	0.3	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	9.2
HCM 2010 LOS	A

Intersection	
Intersection Delay, s/veh	9.2
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	353	315	442
Demand Flow Rate, veh/h	360	321	451
Vehicles Circulating, veh/h	365	97	171
Vehicles Exiting, veh/h	257	628	247
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.9	6.8	9.6
Approach LOS	B	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	360	321	451
Cap Entry Lane, veh/h	784	1025	952
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	353	315	442
Cap Entry, veh/h	769	1005	933
V/C Ratio	0.459	0.313	0.474
Control Delay, s/veh	10.9	6.8	9.6
LOS	B	A	A
95th %tile Queue, veh	2	1	3

Intersection	
Intersection Delay, s/veh	5.6
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	195	252	0	200
Demand Flow Rate, veh/h	198	257	0	204
Vehicles Circulating, veh/h	183	21	381	64
Vehicles Exiting, veh/h	85	360	0	214
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	6.0	5.5	0.0	5.3
Approach LOS	A	A	-	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	198	257	0	204
Cap Entry Lane, veh/h	941	1106	772	1060
Entry HV Adj Factor	0.982	0.980	1.000	0.980
Flow Entry, veh/h	195	252	0	200
Cap Entry, veh/h	924	1084	772	1039
V/C Ratio	0.210	0.232	0.000	0.192
Control Delay, s/veh	6.0	5.5	4.7	5.3
LOS	A	A	A	A
95th %tile Queue, veh	1	1	0	1

Intersection	
Intersection Delay, s/veh	8.5
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	289	363	373
Demand Flow Rate, veh/h	295	370	380
Vehicles Circulating, veh/h	273	91	273
Vehicles Exiting, veh/h	380	477	188
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.2	7.3	9.8
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	295	370	380
Cap Entry Lane, veh/h	860	1032	860
Entry HV Adj Factor	0.980	0.980	0.982
Flow Entry, veh/h	289	363	373
Cap Entry, veh/h	843	1011	844
V/C Ratio	0.343	0.359	0.442
Control Delay, s/veh	8.2	7.3	9.8
LOS	A	A	A
95th %tile Queue, veh	2	2	2

Intersection	
Intersection Delay, s/veh	6.4
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	100	374	0	237
Demand Flow Rate, veh/h	102	381	0	241
Vehicles Circulating, veh/h	220	27	322	161
Vehicles Exiting, veh/h	182	295	0	247
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	5.1	6.8	0.0	6.3
Approach LOS	A	A	-	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	102	381	0	241
Cap Entry Lane, veh/h	907	1100	819	962
Entry HV Adj Factor	0.976	0.981	1.000	0.983
Flow Entry, veh/h	100	374	0	237
Cap Entry, veh/h	885	1079	819	946
V/C Ratio	0.112	0.346	0.000	0.251
Control Delay, s/veh	5.1	6.8	4.4	6.3
LOS	A	A	A	A
95th %tile Queue, veh	0	2	0	1

Five (5) Year Development Capacity Results

Signalized Intersection
Roundabout

Intersection	
Intersection Delay, s/veh	24.8
Intersection LOS	C

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	663	547	605
Demand Flow Rate, veh/h	676	558	617
Vehicles Circulating, veh/h	375	220	408
Vehicles Exiting, veh/h	650	831	370
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	31.9	13.4	27.3
Approach LOS	D	B	D

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	676	558	617
Cap Entry Lane, veh/h	777	907	751
Entry HV Adj Factor	0.981	0.980	0.981
Flow Entry, veh/h	663	547	605
Cap Entry, veh/h	762	889	737
V/C Ratio	0.870	0.615	0.821
Control Delay, s/veh	31.9	13.4	27.3
LOS	D	B	D
95th %tile Queue, veh	11	4	9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	60	165	0	0	60	545	0	0	0	465	0	50
Number	5	2	12	1	6	16	3	8	18	7	4	14
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	1863	1863	1900	1900	1863	1863	1900	1863	1900	1863	0	1863
Adj Flow Rate, veh/h	63	174	0	0	63	574	0	0	0	489	0	53
Adj No. of Lanes	1	1	0	0	1	1	0	1	0	1	0	1
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	0	2
Cap, veh/h	470	855	0	0	651	1061	0	3	0	701	0	0
Arrive On Green	0.05	0.46	0.00	0.00	0.35	0.35	0.00	0.00	0.00	0.32	0.00	0.00
Sat Flow, veh/h	1774	1863	0	0	1863	1583	0	-111765	0	1774	489	
Grp Volume(v), veh/h	63	174	0	0	63	574	0	0	0	489	18.5	
Grp Sat Flow(s),veh/h/ln	1774	1863	0	0	1863	1583	0	1863	0	1774	B	
Q Serve(g_s), s	1.1	3.0	0.0	0.0	1.2	10.2	0.0	0.0	0.0	14.0		
Cycle Q Clear(g_c), s	1.1	3.0	0.0	0.0	1.2	10.2	0.0	0.0	0.0	14.0		
Prop In Lane	1.00		0.00	0.00		1.00	0.00		0.00	1.00		
Lane Grp Cap(c), veh/h	470	855	0	0	651	1061	0	3	0	701		
V/C Ratio(X)	0.13	0.20	0.00	0.00	0.10	0.54	0.00	0.00	0.00	0.70		
Avail Cap(c_a), veh/h	667	855	0	0	651	1061	0	205	0	1142		
HCM Platoon Ratio	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	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00		
Uniform Delay (d), s/veh	9.2	8.8	0.0	0.0	11.9	4.6	0.0	0.0	0.0	17.3		
Incr Delay (d2), s/veh	0.1	0.5	0.0	0.0	0.3	2.0	0.0	0.0	0.0	1.3		
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		
%ile BackOfQ(95%),veh/ln	1.0	3.0	0.0	0.0	1.2	8.5	0.0	0.0	0.0	11.2		
LnGrp Delay(d),s/veh	9.4	9.3	0.0	0.0	12.2	6.6	0.0	0.0	0.0	18.5		
LnGrp LOS	A	A			B	A				B		
Approach Vol, veh/h		237			637			0				
Approach Delay, s/veh		9.3			7.2			0.0				
Approach LOS		A			A							

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2			5	6	7	8
Phs Duration (G+Y+Rc), s		31.0			6.0	25.0	23.5	0.0
Change Period (Y+Rc), s		6.0			3.5	6.0	6.0	6.0
Max Green Setting (Gmax), s		25.0			8.5	13.0	31.0	6.0
Max Q Clear Time (g_c+I1), s		5.0			3.1	12.2	16.0	0.0
Green Ext Time (p_c), s		3.3			0.0	0.3	1.4	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	11.6
HCM 2010 LOS	B

Intersection	
Intersection Delay, s/veh	27.0
Intersection LOS	D

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	721	632	548
Demand Flow Rate, veh/h	735	645	558
Vehicles Circulating, veh/h	279	263	548
Vehicles Exiting, veh/h	827	751	360
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	28.6	19.1	33.9
Approach LOS	D	C	D

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	735	645	558
Cap Entry Lane, veh/h	855	869	653
Entry HV Adj Factor	0.981	0.980	0.982
Flow Entry, veh/h	721	632	548
Cap Entry, veh/h	838	851	642
V/C Ratio	0.860	0.743	0.854
Control Delay, s/veh	28.6	19.1	33.9
LOS	D	C	D
95th %tile Queue, veh	11	7	10

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	70	70	0	0	150	620	0	0	0	615	0	70
Number	5	2	12	1	6	16	3	8	18	7	4	14
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	1863	1863	1900	1900	1863	1863	1900	1863	1900	1863	0	1863
Adj Flow Rate, veh/h	74	74	0	0	158	653	0	0	0	647	0	74
Adj No. of Lanes	1	1	0	0	1	1	0	1	0	1	0	1
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	0	2
Cap, veh/h	347	700	0	0	492	1067	0	3	0	856	0	0
Arrive On Green	0.05	0.38	0.00	0.00	0.26	0.26	0.00	0.00	0.00	0.41	0.00	0.00
Sat Flow, veh/h	1774	1863	0	0	1863	1583	0	-111765	0	1774	647	
Grp Volume(v), veh/h	74	74	0	0	158	653	0	0	0	647	16.8	
Grp Sat Flow(s),veh/h/ln	1774	1863	0	0	1863	1583	0	1863	0	1774	B	
Q Serve(g_s), s	1.6	1.4	0.0	0.0	3.8	12.8	0.0	0.0	0.0	18.9		
Cycle Q Clear(g_c), s	1.6	1.4	0.0	0.0	3.8	12.8	0.0	0.0	0.0	18.9		
Prop In Lane	1.00		0.00	0.00		1.00	0.00		0.00	1.00		
Lane Grp Cap(c), veh/h	347	700	0	0	492	1067	0	3	0	856		
V/C Ratio(X)	0.21	0.11	0.00	0.00	0.32	0.61	0.00	0.00	0.00	0.76		
Avail Cap(c_a), veh/h	530	700	0	0	492	1067	0	200	0	1239		
HCM Platoon Ratio	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	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00		
Uniform Delay (d), s/veh	12.7	11.4	0.0	0.0	16.5	5.1	0.0	0.0	0.0	15.2		
Incr Delay (d2), s/veh	0.3	0.3	0.0	0.0	1.7	2.6	0.0	0.0	0.0	1.6		
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		
%ile BackOfQ(95%),veh/ln	1.4	1.4	0.0	0.0	3.9	10.4	0.0	0.0	0.0	14.4		
LnGrp Delay(d),s/veh	13.0	11.7	0.0	0.0	18.3	7.7	0.0	0.0	0.0	16.8		
LnGrp LOS	B	B			B	A				B		
Approach Vol, veh/h		148			811			0				
Approach Delay, s/veh		12.3			9.7			0.0				
Approach LOS		B			A							

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2			5	6	7	8
Phs Duration (G+Y+Rc), s		27.0			6.2	20.8	28.9	0.0
Change Period (Y+Rc), s		6.0			3.5	6.0	6.0	6.0
Max Green Setting (Gmax), s		21.0			8.5	9.0	35.0	6.0
Max Q Clear Time (g_c+I1), s		3.4			3.6	14.8	20.9	0.0
Green Ext Time (p_c), s		3.6			0.0	0.0	2.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	12.8
HCM 2010 LOS	B

Intersection	
Intersection Delay, s/veh	24.8
Intersection LOS	C

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	663	547	605
Demand Flow Rate, veh/h	676	558	617
Vehicles Circulating, veh/h	375	220	408
Vehicles Exiting, veh/h	650	831	370
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	31.9	13.4	27.3
Approach LOS	D	B	D

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	676	558	617
Cap Entry Lane, veh/h	777	907	751
Entry HV Adj Factor	0.981	0.980	0.981
Flow Entry, veh/h	663	547	605
Cap Entry, veh/h	762	889	737
V/C Ratio	0.870	0.615	0.821
Control Delay, s/veh	31.9	13.4	27.3
LOS	D	B	D
95th %tile Queue, veh	11	4	9

Intersection	
Intersection Delay, s/veh	10.7
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	237	637	0	542
Demand Flow Rate, veh/h	241	649	0	553
Vehicles Circulating, veh/h	499	64	740	64
Vehicles Exiting, veh/h	118	676	0	649
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	10.0	11.8	0.0	9.8
Approach LOS	A	B	-	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	241	649	0	553
Cap Entry Lane, veh/h	686	1060	539	1060
Entry HV Adj Factor	0.981	0.981	1.000	0.980
Flow Entry, veh/h	237	637	0	542
Cap Entry, veh/h	673	1040	539	1039
V/C Ratio	0.351	0.612	0.000	0.522
Control Delay, s/veh	10.0	11.8	6.7	9.8
LOS	A	B	A	A
95th %tile Queue, veh	2	4	0	3

Intersection	
Intersection Delay, s/veh	27.0
Intersection LOS	D

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	721	632	548
Demand Flow Rate, veh/h	735	645	558
Vehicles Circulating, veh/h	279	263	548
Vehicles Exiting, veh/h	827	751	360
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	28.6	19.1	33.9
Approach LOS	D	C	D

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	735	645	558
Cap Entry Lane, veh/h	855	869	653
Entry HV Adj Factor	0.981	0.980	0.982
Flow Entry, veh/h	721	632	548
Cap Entry, veh/h	838	851	642
V/C Ratio	0.860	0.743	0.854
Control Delay, s/veh	28.6	19.1	33.9
LOS	D	C	D
95th %tile Queue, veh	11	7	10

Intersection	
Intersection Delay, s/veh	18.2
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	148	811	0	721
Demand Flow Rate, veh/h	150	827	0	735
Vehicles Circulating, veh/h	660	75	810	161
Vehicles Exiting, veh/h	236	735	0	741
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	9.7	19.1	0.0	18.8
Approach LOS	A	C	-	C

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	150	827	0	735
Cap Entry Lane, veh/h	584	1048	503	962
Entry HV Adj Factor	0.984	0.980	1.000	0.981
Flow Entry, veh/h	148	811	0	721
Cap Entry, veh/h	574	1028	503	944
V/C Ratio	0.257	0.789	0.000	0.764
Control Delay, s/veh	9.7	19.1	7.2	18.8
LOS	A	C	A	C
95th %tile Queue, veh	1	9	0	8

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