



CREATION TO COMPLETION

TRAFFIC IMPACT STUDY

For

**PROPOSED SPEEDWAY
DEVELOPMENT**

**Located at
Northwest corner
Of
U.S. 23 and Hills-Miller Road
City of Delaware, Ohio**

**Prepared by:
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1 Executive Summary

1.1 Summary

1. This report is prepared on behalf of Speedway in connection with their proposed development site plan. The proposed Speedway development is comprised of 17 fueling stations (3 tractor-trailer fueling stations and 14 passenger vehicle fueling stations) and a 4600 square foot convenience market. The site plan shows two driveway connections; one right-in/right-out access on U.S. 23 and an unrestricted access to Hills-Miller Road. U.S. 23 and Hills-Miller Road, in this area, are under the jurisdiction of the City of Delaware. The Ohio Department of Transportation (ODOT) District 6 and Delaware County Engineer's Office will be provided copies of this Traffic Impact Study (TIS) for a courtesy review.

This report presents the methodologies, analyses, and results of the TIS for traffic generated by the Speedway development located at the northwest corner of U.S. 23 and Hills-Miller Road in Delaware, Ohio.

The purpose of the TIS is to identify the traffic related impacts during typical weekday A.M. and P.M. peak hours of the adjacent street(s) traffic corresponding with the weekday hours of operation for the proposed use of the Site as a Speedway development.

2. The TIS focused on evaluating the Opening Year 2015 Build condition, 2015 No-Build condition, Design Year 2035 Build condition and Design Year 2035 No-Build condition, at the site driveways on U.S. 23 and Hills-Miller Road as well as the intersection of U.S. 23 and Hills-Miller Road.

The term "Build" means the first day of the use of the Site as a Speedway development.

The four (4) traffic scenarios analyzed were:

2015 Opening Year Background (No-Build) Scenario – Represents traffic conditions that will exist on the roadway during year 2015 without the proposed mixed-use development.

2015 Opening Year Build Traffic Scenario – Represents traffic conditions that would exist during year 2015 as Opening Day of the Speedway development.

2035 Design Year Background (No-Build) Traffic Scenario – Represent traffic conditions that would exist on the roadway system during year 2035 without the proposed use of the Site as a Speedway development.

2035 Design Year Build Traffic Scenario – Represents traffic conditions that would exist during year 2035 as Design Year of the Speedway development.



3. Site Access: One proposed unrestricted access along the north side of Hills-Miller Road located approximately 475' west of U.S. 23. One proposed right-in/right-out access along the west side of U.S. 23 approximately 720' north of Hills-Miller Road.
4. Traffic counts (manual) were conducted by CESO:
 - Tuesday June 3, 2014 at the intersection of U.S. 23/Hills-Miller Road from 7:15 a.m. - 9:15 a.m. and from 4:15 p.m. - 6:15 p.m.
 - 24 hour counts on Tuesday June 17 beginning at 9:00 a.m. through Wednesday June 18, 2014 at 9:00 a.m.
5. The weekday A.M. and P.M. peak hours were determined to occur between the hours of:
 - 7:15 a.m. - 8:15 a.m.
 - 4:45 p.m. - 5:45 p.m.
6. A growth rate of 1.7% was provided by the City of Delaware.
7. Crash data was obtained from the Ohio Department of Public Safety. Crash data for calendar years 2011-2013 for the intersection of U.S. 23/Hills-Miller Road intersection was reviewed for date, and circumstance.

The conclusions and recommendations of this Traffic Impact Study are as follows:

1.2 Conclusions

Background (No Build) 2015 Opening Year Traffic Scenario

1. 2015 Background Traffic Scenario represents traffic conditions that will exist on the roadway during year 2015 without the proposed Speedway development. The Background 2015 traffic scenario analyzed the 2014 traffic volumes increased by a 1.7% growth rate. The level of service of the U.S. 23/Hills-Miller intersection was analyzed using Synchro Version 8 and the northbound turn lane length was analyzed utilizing ODOT's L&D Manual Volume One, Figures 401-9E and 401-10-E. A.M and P.M. peak hours were analyzed.

Build 2015 Opening Year Traffic Scenario

2. 2015 Build traffic scenario represent traffic conditions that would exist during year 2015 with proposed use of the Site as a Speedway development. The 2015 traffic scenario included adding the trips generated by the Speedway to the background (Year 2015) traffic volumes. Opening Day of the development was analyzed for full-build of the development traffic and took into account 100% of the total trips generated for the Speedway Service Station and Convenience Store development.

The level of service of the U.S. 23/Hills-Miller intersection was analyzed using Synchro Version 8 and the northbound turn lane length was analyzed utilizing ODOT's



L&D Manual Volume One, Figures 401-9E and 401-10E. A.M and P.M. peak hours were analyzed. Turn lanes warrants at the proposed site driveways were analyzed using the turn lane graphs from ODOT’s & L&D Manual Volume One, Section 400.

Trip generation for the site was established using the ITE Manual, 9th, Edition. ITE Land Use Code 945, Service Station with Convenience Market.

Build condition is assumed to generate 172 trips during the Weekday A.M. Peak Hour (86 inbound and 86 outbound) and 230 trips will be generated during the P.M. Peak Hour (115 inbound and 115 outbound). **Table One** illustrates the peak hour trips.

Per the ITE Manual, 9th Edition, there is a Pass-by trip reduction for the Service Station with Convenience Market code; 62% in the A.M. Peak and 56% during the P.M. Peak. These percentages and reduction of trips are shown in **Table One**.

TABLE 1
Speedway Development
Generated Traffic Volumes

| ITE TRIP GENERATION | | UNIT | TRIP ENDS | | | | | |
|---------------------|---|----------------------|-------------------------------|----|-----|-------------------------------|----|-----|
| ITE Code | Description | | Weekday | | | | | |
| | | | A.M. Peak (In/Out/Pass-by) | | | P.M. Peak (In/Out/Pass-by) | | |
| 945 | Service Station with Convenience Market | 17 Fueling Positions | 33 | 33 | 106 | 50 | 50 | 130 |
| Totals | | | 172 | | | 230 | | |

Background (No Build) 2035 Design Year Traffic

3. Represent traffic conditions that would exist on the roadway system during year 2035 without the proposed use of the Site as a Speedway development. The level of service of the U.S. 23/Hills-Miller intersection was analyzed using Synchro Version 8 and the northbound turn lane length was analyzed utilizing ODOT’s L&D Manual Volume One, Figures 401-9E and 401-10E. A.M and P.M. peak hours were analyzed.



Build 2035 Design Year Traffic Scenario

4. Represents traffic conditions that would exist during year 2035 as Design Year of the Speedway development. The 2035 traffic scenario included adding the trips generated by the Speedway in 2015 to the background (Year 2035) traffic volumes.

The level of service of the U.S. 23/Hills-Miller intersection was analyzed using Synchro Version 8 and the northbound turn lane length was analyzed utilizing ODOT's

L&D Manual Volume One, Figures 401-9E and 401-10E. A.M and P.M. peak hours were analyzed. Turn lanes warrants at the proposed site driveways were analyzed using the turn lane graphs from ODOT's & L&D Manual Volume One, Section 400.

1.3 Recommendations

The following summary of recommendations was determined for Existing, Background, and Build Traffic scenarios. All recommended improvements are required by the City of Delaware to be constructed prior to opening day, regardless of the year in which they are warranted.

2015 No-Build Traffic Scenario:

No improvements are recommended.

2015 Build Traffic Scenario: (Speedway)

Construct a southbound right turn lane on U.S. 23 at the proposed right-in/right-out access. The turn lane should be 285' in length which includes the 50' diverging taper. The existing northbound left turn lane on U.S. 23 is approximately 10' wide. The City of Delaware has required that U.S. 23 northbound be widened in order to accommodate three, 12' wide, northbound lanes to meet current ODOT standards. This study finds the need to lengthen the existing northbound left turn lane to meet ODOT standards, but does not recommend for the turn lane to be lengthened due to an existing commercial drive on US 23 immediately south of the existing left turn lane. The existing northbound left turn lane should be restriped per OMUTCD Figure 3B-7 for the transition from two-way left turn lane to a dedicated northbound left turn lane.

2035 Background Traffic Scenario:

No improvements are recommended.

2035 Build Traffic Scenario: (Speedway)

Construct an eastbound left turn lane on Hills-Miller road at the intersection of U.S. 23. Turn lane should be 261' in length which includes the 50' diverging taper. Queuing analysis shows that the eastbound lanes will not accumulate queues longer than 261'. The City of Delaware has required that Hills-Miller road be widened from the western property line of the Speedway parcel to U.S. 23 creating a three lane section with 12' lane widths. Tapering to the existing two lane section of Hills-Miller road will be accomplished through striping, therefore additional widening west of the parcel line is not required by the City.



2 Introduction

This report is prepared on behalf of Speedway in connection with their proposed development at the northwest corner of U.S. 23 and Hills-Miller Road.

The use of the Site as Speedway development will generate additional traffic on U.S. 23 and Hills-Miller Road. Speedway retained CESO, Inc. to prepare this traffic impact study and present the details of a safe and efficient access system in connection with their development for approval of the following:

- (i) Conduct work within the right-of-way of U.S. 23, along the west side, for construction of a right-in/right-out access located approximately 720' north of Hills-Miller Road. U.S. 23 at this location is within the jurisdiction of the City of Delaware.
- (ii) Requests approval to conduct work within the right-of-way of Hills-Miller Road, along the north side, for construction of a sixty-five (65) foot stopped controlled full access located approximately 300' west of U.S. 23. Hills-Miller Road is under the jurisdiction of the City of Delaware.

This report presents the methodologies, analyses, and results of the Traffic Impact Study (TIS) for traffic generated by a proposed Service Station with Convenience Market that includes 17 fueling positions and a 4600 square foot building.

The purpose of the TIS was to identify the traffic related impacts during typical weekday A.M. and P.M. peak hours of the adjacent street traffic corresponding with the weekday hours of operation for the proposed use of the Site as a Speedway development.

This study focused on evaluating U.S. 23 and Hills-Miller Road including the proposed site driveway(s) under four (4) traffic scenarios and is summarized as follows:

2015 Opening Year No-Build Scenario – Represents traffic conditions that will exist on the roadway during year 2015 without the proposed Speedway development.

2015 Opening Year Build Traffic Scenario – Represents traffic conditions that would exist during year 2015 as Opening Day of the Speedway development.

2035 Design Year No-Build Traffic Scenario – Represent traffic conditions that would exist on the roadway system during year 2035 without the proposed Speedway development.

2035 Design Year Build Traffic Scenario – Represents traffic conditions that would exist during year 2035 as Design Year of the Speedway development.

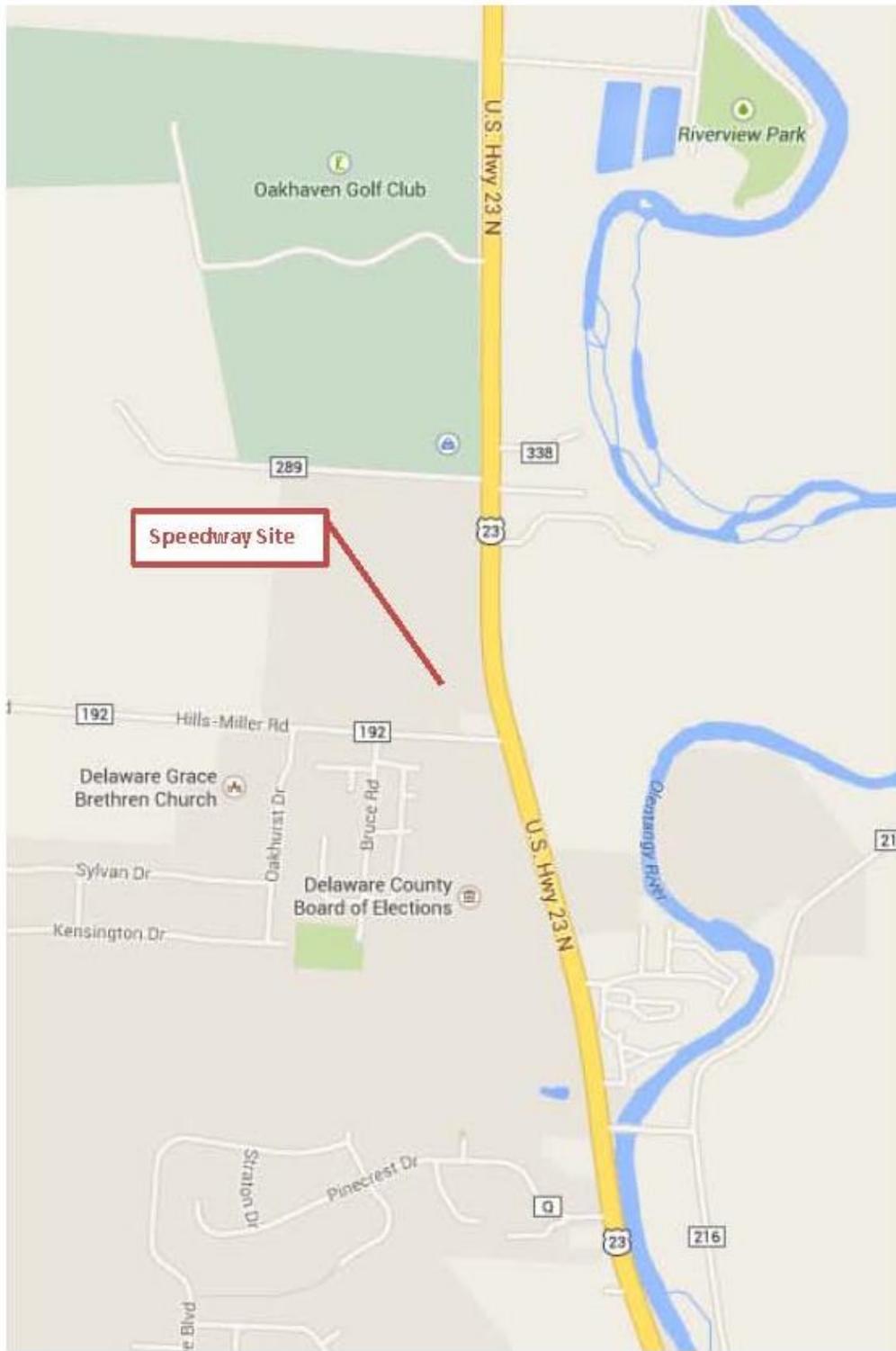


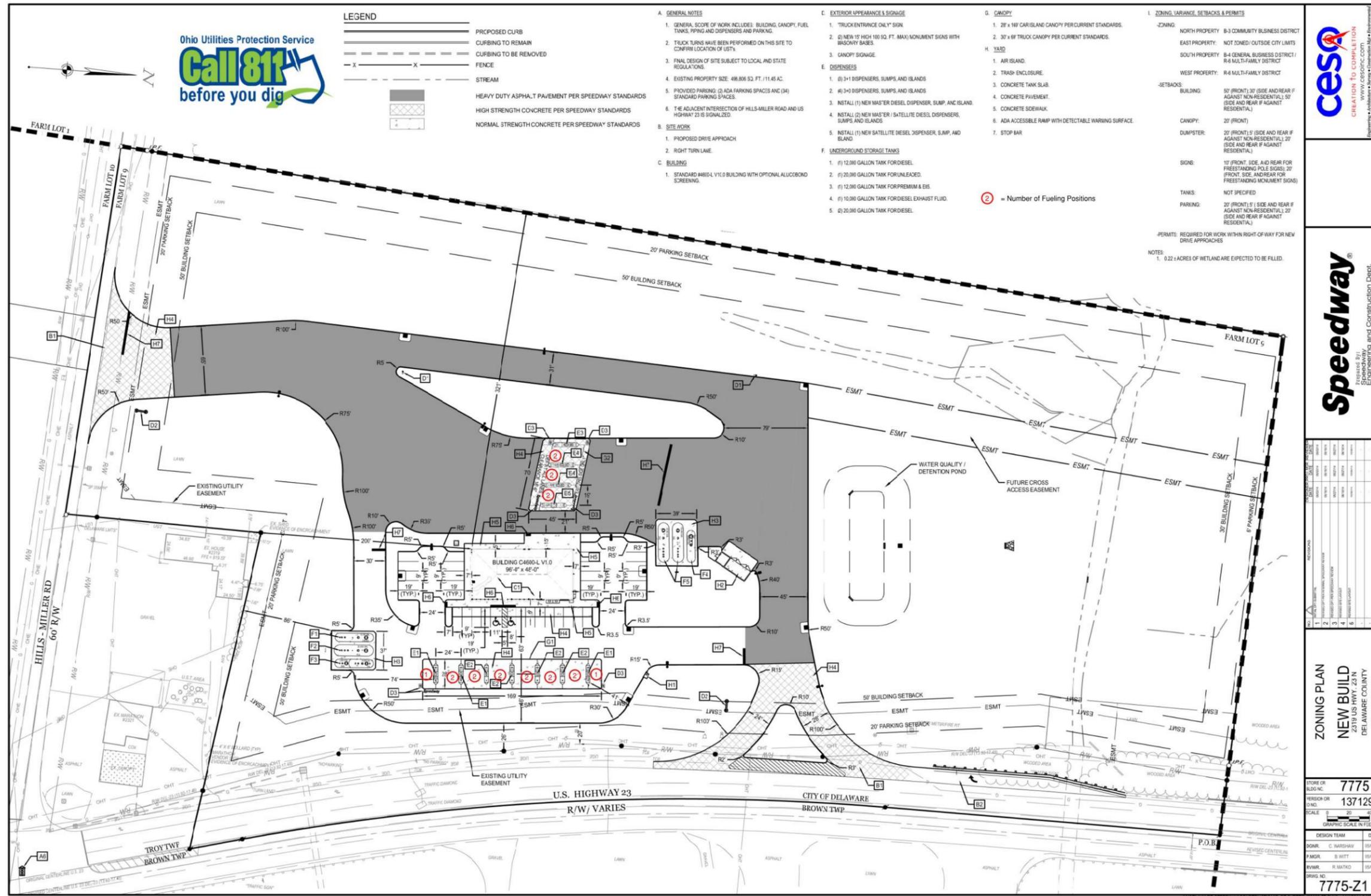
The Site is located at the Northwest corner of U.S. 23 and Hills-Miller Road in Delaware, Ohio.

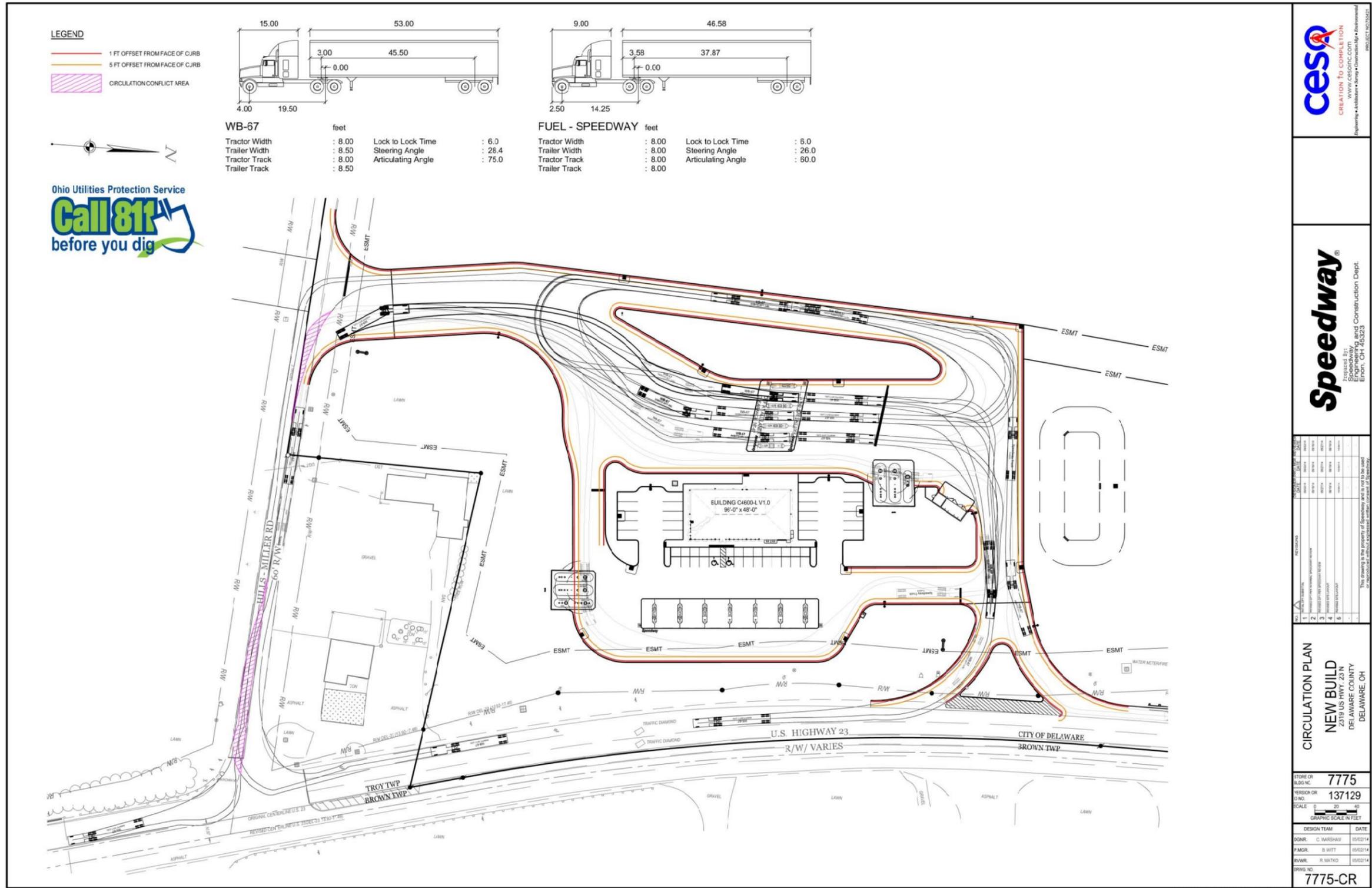
Figure 1 illustrates the site location with respect to the study area, *Figure 2* illustrates the site property plan for the proposed Speedway development and *Figure 3* illustrates the site circulation.

This report summarizes the data collection, analysis of traffic impacts, proposed accesses, and conclusions from the analysis.

Figure 1







2.1 Study Procedure

The following studies and analyses were undertaken:

- 1) A field inspection of the locations within the study area was completed by CESO, Inc. to identify existing roadway geometrics, posted speed limits, and in-place traffic control.
- 2) Crash data was obtained from the Ohio Department of Public Safety. Crash data for calendar years 2011-2013 for the intersection of U.S. 23/Hills-Miller Road intersection was reviewed for date, and circumstance.
- 3) Traffic counts were conducted by CESO:
 - Tuesday June 3, 2014 at the intersection of U.S. 23/Hills-Miller Road from 7:15 a.m. - 9:15 a.m. and from 4:15 p.m. - 6:15 p.m.
 - 24 hour counts on Tuesday June 17 beginning at 9:00 a.m. through Wednesday June 18, 2014 at 9:00 a.m.
- 4) Perform analysis to determine the potential traffic generated under the 2015 Build Traffic Scenarios utilizing data provided in the Institute of Transportation Engineers' Trip Generation Manual, 9th Edition, Land Use 945 Service Station with Convenient Market.
- 5) Directional distribution analysis to determine the potential distribution of patrons for the proposed use of the Site as Speedway development under the 2015 Build and 2035 Build Traffic Scenarios.
- 6) Increase the Existing Weekday Peak Hour Traffic Volumes by a 1.7% growth rate one (1) year to arrive at 2015 Opening Year No-Build traffic volumes.
- 7) Add the traffic for the proposed use of the Site as a mixed-use development to the Existing Weekday Peak Hour Traffic Volumes to reflect the 2015 Build Weekday Peak Hour traffic volumes.
- 8) Increase the Existing Weekday Peak Hour Traffic Volumes by a 1.7% growth rate for twenty (21) years to arrive at 2035 Background traffic volumes.
- 9) Add the traffic for the proposed use of the Site as a retail development to the 2035 Background Weekday Peak Hour Traffic Volumes to reflect the 2035 Build Weekday Peak Hour traffic volumes.
- 10) Turn lane analysis to determine whether turn lanes are warranted for the development using turn lane graphs from ODOT's L&D Manual Volume One.

2.2 References

This report utilizes information provided by the following sources:

1. The Institute of Transportation Engineers' Trip Generation Manual, 9th Edition and the Trip Generation Handbook.

2. Most recent site property plan.
3. The Ohio Manual of Uniform Traffic Control Devices (OMUTCD).
4. The City of Delaware's Traffic Impact Study Standards.
5. ODOT L&D Volume One figures 401-5aE, 401-6aE and 401-6dE right and turn lane Graphs.
6. ODOT L&D Volume One figures 401-9E and 401-10E.
7. Synchro Version 8
8. SimTraffic

3 Roadway and Traffic Conditions in the Vicinity of the Site

An inventory of existing transportation conditions in the vicinity of the site was created to form a database for use in projecting future conditions.

3.1 Study Location and Area Land Use

The Site is located on the west side of U.S. 23 at the northwest corner of U.S. 23 and Hills-Miller Road in Delaware, Ohio.

Speedway requests approval of a driveway connection to U.S. 23 and to Hills-Miller Road and will request approval to conduct work within the right-of-way of these two public roadways for construction of a stop sign controlled right-in/right-out access on U.S. 23 and a stop sign controlled unrestricted access on Hills-Miller Road. Land uses in the area along U.S. 23 are primarily commercial use and along Hills-Miller Road are primarily single family residences and multi-family.

3.2 Area Roadway Characteristics

U.S. 23 in the vicinity of the Site is a five (5) lane principal arterial roadway, consisting of two (2) northbound lanes, two (2) southbound lanes and a center left turn lane. Hills-Miller Road in the vicinity of the Site is a two (2) lane roadway consisting of one (1) eastbound and one (1) westbound lane.

The lane widths for U.S. 23 south of Hills-Miller Road are:

- Southbound inside lane is 11' and outside lane is 12'.
- Northbound inside lane is 11' and outside lane is 12'.
- Northbound left turn lane is 10'.



The lane widths are illustrated in *Figure 4*.

The posted speed limit on U.S. 23 in the vicinity of the Site is 55 mph and the posted speed limit on Hills-Miller Road is 35 mph.

3.3 Existing Traffic Volumes

Traffic counts were conducted by CESO, Inc. on:

- Tuesday June 3, 2014 at the intersection of U.S. 23/Hills-Miller Road from 7:15 a.m. - 9:15 a.m. and from 4:15 p.m. - 6:15 p.m.
- 24 hour counts on Tuesday June 17 beginning at 9:00 a.m. through Wednesday June 18, 2014 at 9:00 a.m.

The weekday peak hours were determined to occur between the hours of: 7:15 a.m. - 8:15 a.m. and 4:45 p.m. - 5:45 p.m.

The average daily traffic (ADT) on U.S. 23 is approximately 17,000 vehicles. In a town hall meeting, the proposed development was incorrectly compared to large truck stops similar to those on U.S. 36 adjacent to Interstate 71. It is important to note the extreme differences between these two scenarios in both traffic and development type. In regards to traffic Interstate 71 has much greater vehicle and truck volumes than U.S. 23. According to the Mid-Ohio Regional Planning Council (MORPC), the ADT on Interstate 71 just south of U.S. 36 was 70,420 in a 2008 count and the ADT on U.S. 36 between Interstate 71 and the truck stops was 24,840 in a 2008 count. The truck stops on U.S. 36 are intended to bring trucks off on Interstate 71 and onto U.S. 36 to access the sites. Also, truck stops offer many services (restaurants, showers, truck scales, maintenance shops, etc.), that will not be offered by Speedway, in order to draw trucks off of Interstate 71 and onto U.S. 36. The proposed development will service the truck traffic that is already using U.S. 23 and not draw trucks off of interstate highways such as Interstate 71.

The existing traffic counts are shown in *Appendix A*.



4 Estimates of 2015 Build Traffic in the Vicinity of the Site

2015 No-Build Peak Hour Traffic Volumes were calculated by increasing the Existing Weekday Peak Hour Traffic Volumes by 1.7% per year growth factor for one (1) year. A growth factor of 1.7% was used per the City of Delaware. The 2015 Build traffic volumes were then calculated by adding the traffic estimated for the proposed use of the Site as a mixed-use development to the Existing Weekday Peak Hour Traffic Volumes.

4.1 2015 Mixed-Use Development-Generated Traffic Volumes

Studies of similar developments throughout North America have shown that the amount of traffic generated will be functionally related to some unit of activity (i.e., number of fueling positions). In addition, Site traffic fluctuates substantially on different days and hours throughout the year. Therefore, it is imperative to select an appropriate hourly volume on which to base the design of the external roadway and site access facilities. The Weekday A.M. and P.M. Peak Hours were selected based on the adjacent street traffic during these hours.

The 2015 Build Traffic Scenario included the proposed use of the Site as a Speedway development.

For analysis purposes, the unit used as the base variable for the trip-generation rate was the number of fueling positions. Utilizing data contained in the Institute of Transportation Engineers (ITE) Trip Generation Manual, 9th Edition, and methods outlined in the (ITE) Trip Generation Handbook.

The traffic estimated for the proposed use of the Site as a Speedway development was added to the Existing Weekday Peak Hour Traffic Volumes which served as a basis in the development of any potential recommended roadway improvements for the 2015 Build Traffic Scenario. 2015 Background and Build Conditions are illustrated in *Appendices C & D*.

4.2 Directional Distribution of the Development-Generated Traffic Volumes

The directional distribution of the Site-generated traffic is a function of several variables. The assumptions and methods used in estimating the direction in which traffic will approach and depart the site varies with several location-specific conditions such as:

- Size & type of the proposed development
- Population distribution within the defined area of influence
- Prevailing operating conditions on the existing street system

The analysis of directional distribution is based on the observation that drivers normally will choose the fastest (not necessarily the most direct) routes to and from a given traffic generator.



The directional distribution of trips generated by the proposed use of the Site as a Service Station with Convenience Market development is shown in Table 2.

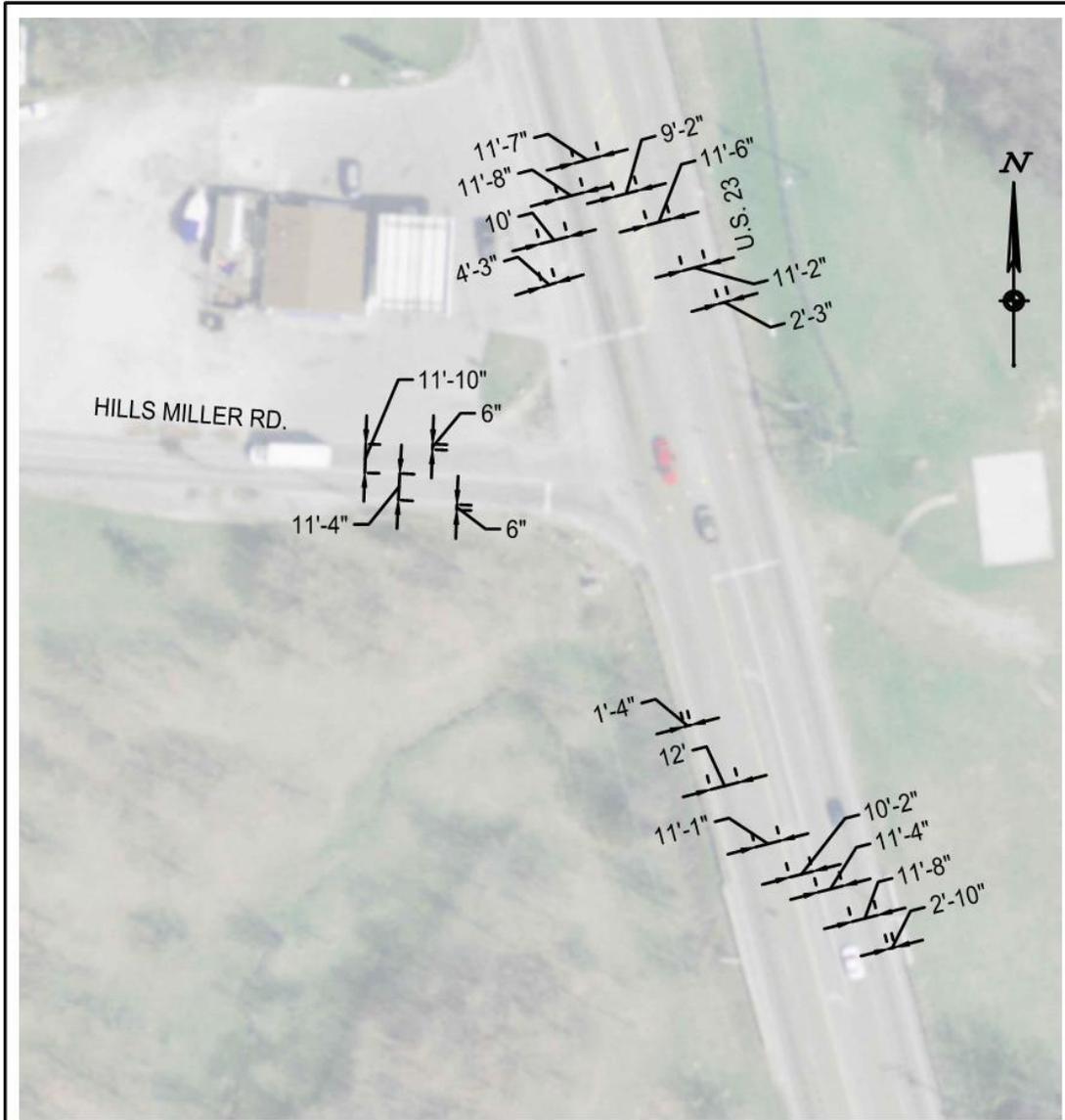
Table 2
Directional Distribution of Speedway
Development-Generated Traffic Volumes

| Route | Approach/Departure Primary Trip Distribution | |
|---------------|---|---------|
| | AM Peak | PM Peak |
| From North | 50% | 35% |
| From South | 35% | 50% |
| From West | 15% | 15% |
| Totals | 100% | 100% |

Based on the directional distributions shown in Table 2 the estimated traffic volumes were distributed to the adjacent roadway system to determine 2015 Build Conditions.

The distributions of trips to and from the site are shown in *Appendix B*.

FIGURE 4



US 23 LANE WIDTHS

| | | |
|---|--|-----------------|
|  CREATION TO COMPLETION www.cesoinc.com <small>Engineering • Architecture • Survey • Construction Mgt • Environmental</small> | SPEEDWAY #100359 US HWY 23 & HILLS MILLER RD. DELAWARE, OH | JOB NO.: 750421 |
| | | DESIGN: TJL |
| | | DATE: NOV. 2014 |
| | | FIGURE NO. 4 |

5 Estimates of 2035 Build Traffic in the Vicinity of the Site

2035 No-Build Peak Hour Traffic Volumes were calculated by increasing the Existing Weekday Peak Hour Traffic Volumes by 1.7% per year growth factor for twenty-one (21) years. A growth factor of 1.7% was used per the City of Delaware. Then the 2035 Build traffic volumes were calculated by adding the traffic estimated for the proposed use of the Site as a Speedway development to the Existing Weekday Peak Hour Traffic Volumes.

5.1 2035 Mixed-Use Development-Generated Traffic Volumes

The traffic estimated for the proposed use of the Site as a Speedway development was added to the 2035 Design Year Weekday Peak Hour Traffic Volumes which served as a basis in the development of any potential recommended roadway improvements for the 2035 Build Traffic Scenario. 2035 Background and Build Conditions are illustrated in *Appendices E & F*.

5.2 Directional Distribution of the Mixed-Use Development-Generated Traffic Volumes

The directional distribution of trips generated by the proposed use of the Site as a retail development is shown in Table 2.

6 Level of Service of Analyzed Intersections

Synchro version 8 was used for the capacity analysis. A capacity analysis was performed for the 2015 Background & Build Conditions and the 2035 Background & Build Conditions. As required, a level-of-service of “D” or better is maintained during peak hours for all movements when the recommended improvements are constructed.

A Level of Service Table is provided for the 2015 Background and Build conditions (TABLE 3) and the 2035 Background and Build conditions (TABLE 4).

The Synchro analyses are located in *Appendices G-P*.

TABLE 3
Level of Service
2015
Background and Build Conditions

| INTERSECTION | CONTROL | Approach | Level of Service (LOS) | | | |
|--------------------------------|-------------------|----------------|------------------------|-----------------|-----------------|-----------------|
| | | | 2015 BKGD | | 2015 BUILD | |
| | | | A.M. | P.M. | A.M. | P.M. |
| U.S. 23 & Hills Miller Road | Traffic Signal | EBLR | B (14.7) | B (15.6) | C (20.2) | C (31.3) |
| | | NBL | A (6.2) | B (18.5) | B (12.0) | C (34.1) |
| | | NBT | A (6.8) | A (7.1) | A (8.0) | A (9.2) |
| | | SBT | B (15.0) | B (18.3) | B (18.0) | C (28.6) |
| | | SBR | A (4.6) | A (3.5) | A (5.2) | A (5.4) |
| | | Overall | B (11.6) | B (12.7) | B (14.3) | C (20.4) |

*2015 PM Peak Build Condition with recommended improvements

TABLE 4
Level of Service
2035
Background and Build Conditions

| INTERSECTION | CONTROL | Approach | Level of Service (LOS) | | | | |
|--------------------------------|-------------------|----------------|------------------------|-----------------|-----------------|-----------------|-----------------|
| | | | 2035 BKGD | | 2035 BUILD | | IMP* |
| | | | A.M. | P.M. | A.M. | P.M. | P.M. |
| U.S. 23 & Hills Miller Road | Traffic Signal | EBLR | C (32.0) | C (34.9) | D (37.6) | E (67.7) | - |
| | | EBL | - | - | - | - | D (54.0) |
| | | EBR | - | - | - | - | B (12.7) |
| | | NBL | B (15.4) | C (33.0) | D (36.1) | F (87.5) | D (54.7) |
| | | NBT | B (11.5) | A (8.1) | B (11.5) | B (12.7) | A (9.0) |
| | | SBT | C (32.4) | C (34.9) | D (42.8) | E (66.6) | D (43.9) |
| | | SBR | A (4.7) | A (3.4) | A (4.6) | A (4.7) | A (4.0) |
| | | Overall | C (23.8) | C (21.8) | C (30.1) | D (43.4) | C (27.6) |

*2035 P.M. Peak Build Condition with recommended improvements including 261' EBL turn lane

7. Crash Data at Studied Intersection

Crash data was obtained from the Ohio Department of Public Safety. Crash data for calendar years 2011-2013 for the intersection of U.S. 23/Hills-Miller Road intersection was reviewed for date, and circumstance. For calendar year 2011 there were 6 reported crashes; the circumstance for 4 of the crashes was following too closely. For calendar year 2012 there were 5 reported crashes, the circumstance for 2 of the crashes was following too closely. For calendar year 2013 there were 3 reported crashes, the circumstance for 2 of the crashes was following too closely. There were a total of 14 reported crashes for calendar years 2011-2013.

8 Turn Lane Analysis

Turn lane analysis were performed at the proposed Site driveways and the intersection of U.S. 23/Hills-Miller Road.

8.1 Site Driveways Turn Lane Analysis

In the 2015 Build Scenario right turn lane warrants were met for a southbound right turn lane at the proposed site access along U.S.23. The length of this turn lane should be 285' including the diverging taper.

The calculations and worksheets for the southbound U.S. 23 right turn lane are in *Appendix R*.

In the 2015 and 2035 Build Scenarios a right turn lane and left turn lane analysis at the proposed site access along Hills-Miller Road was performed and turn lanes are not warranted.

Turn Lane Graphs are in *Appendix Q*.

8.2 Northbound U.S. 23 Left Turn Lane Length Analysis

The northbound left turn lane length on U.S. 23 to go westbound on Hills-Miller Road was analyzed using figures 401-9E and 401-10E from ODOT's L&D Manual Volume One. The existing length of the turn lane is 245' in length not including the diverging taper. The necessary length for the 2015 Background condition, using figures 401-9E and 401-10E from ODOT's L&D Manual Volume One, is 343', the 2015 Build condition is 393', the 2035 Background condition is 393', and the 2035 Build condition is 468'. All turn lane lengths include the 50' diverging taper.



The calculations and worksheets for the northbound U.S. 23 left turn lane are in ***Appendix R***.

A queuing analysis was performed using SimTraffic to determine the queue that would develop under build conditions with the recommended improvements. For the 2015 Build condition the maximum queue was 155' and the average queue was 120', while for the 2035 Build condition the maximum queue was 258' and the average queue was 185'.

The SimTraffic analyses are located in ***Appendices I-K & N-P***.

The deceleration length per figure 401-9E is 125' and the maximum queue length for the 2035 Build Condition, as shown in SimTraffic, is 268'. These total 393', including the 50' diverging taper. The exclusive northbound U.S. 23 left turn lane, if lengthened, will extend beyond a commercial access on the east side of U.S. 23. This would result in southbound vehicles that are turning left into the commercial access queuing in the southbound through lane prior to turning across the northbound left turn lane. The existing turn 245' turn lane is less than the 343' required in the 2015 Background scenario. Due to the existing substandard nature of the northbound left turn lane and the commercial access conflict that would occur if the turn lane was extended, lengthening of the exclusive northbound left turn lane is not recommended.

8.3 Eastbound Hills-Miller Road Left Turn Lane Length Analysis

In order to meet the City of Delaware TIS standard of a level-of-service of D or better during the peak traffic hours, an eastbound left turn lane length on Hills-Miller Road to go northbound on U.S. 23 was analyzed using figures 401-9E and 401-10E from ODOT's L&D Manual Volume One. The necessary length for the 2015 Build condition, using figures 401-9E and 401-10E from ODOT's L&D Manual Volume One, is 211' and the 2035 Build condition is 261'. All turn lane lengths include the 50' diverging taper. Queuing analysis shows that eastbound lanes will not accumulate queues longer than 261'.

The calculations and worksheets for the eastbound Hills-Miller Road left turn lane are in ***Appendix R***.

9 Traffic Evaluation and Recommendations

9.1 Summary of Recommendations

The following summary of recommendations was determined for Existing, Background, and Build Traffic scenarios. All recommended improvements are required by the City of Delaware to be constructed prior to opening day, regardless of the year in which they are warranted.

2015 No-Build Traffic Scenario:

No improvements are recommended.

2015 Build Traffic Scenario: (Speedway)

Construct a southbound right turn lane on U.S. 23 at the proposed right-in/right-out access. The turn lane should be 285' in length which includes the 50' diverging taper. The existing northbound left turn lane on U.S. 23 is approximately 10' wide. The City of Delaware has required that U.S. 23 northbound be widened in order to accommodate three, 12' wide, northbound lanes to meet current ODOT standards. This study finds the need to lengthen the existing northbound left turn lane to meet ODOT standards, but does not recommend for the turn lane to be lengthened due to an existing commercial drive on US 23 immediately south of the existing left turn lane. The existing northbound left turn lane should be restriped per OMUTCD Figure 3B-7 for the transition from two-way left turn lane to a dedicated northbound left turn lane.

2035 Background Traffic Scenario:

No improvements are recommended.

2035 Build Traffic Scenario: (Speedway)

Construct an eastbound left turn lane on Hills-Miller road at the intersection of U.S. 23. Turn lane should be 261' in length which includes the 50' diverging taper. Queuing analysis shows that the eastbound lanes will not accumulate queues longer than 261'. The City of Delaware has required that Hills-Miller road be widened from the western property line of the Speedway parcel to U.S. 23 creating a three lane section with 12' lane widths. Tapering to the existing two lane section of Hills-Miller road will be accomplished through striping, therefore additional widening west of the parcel line is not required by the City.



TRAFFIC COUNTS

**A
P
P
E
N
D
I
X

A**

CESO, Inc.

8534 Yankee Street, Suite 2B

Dayton, Ohio 45458

Phone: (937) 435-8584

Fax: (937) 435-3307

www.cesoinc.com

Location: Hills-Miller & US 23

Counter:

Counted by: CESO

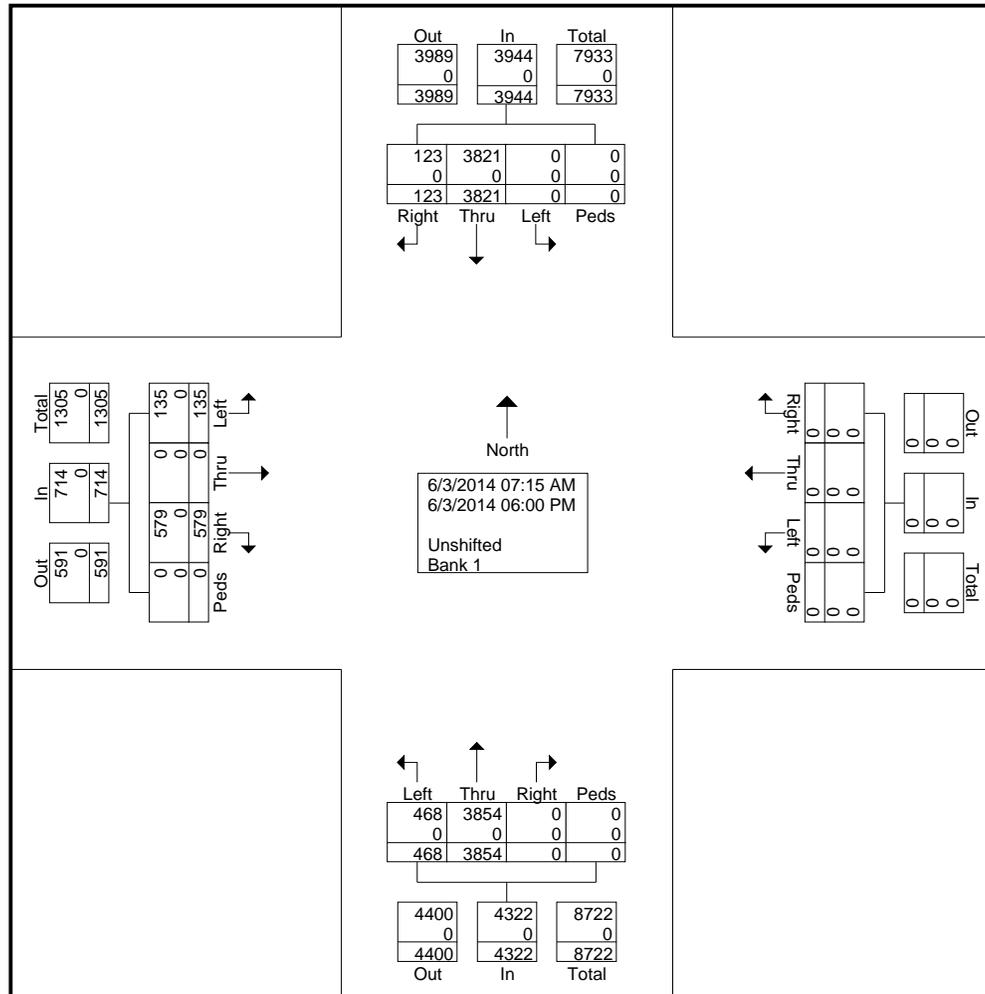
Weather:

File Name : Hills-Miller and US 23

Site Code : 00007775

Start Date : 6/3/2014

Page No : 2



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 8534 Yankee Street, Suite 2B
 Dayton, Ohio 45458
 Phone: (937) 435 - 8584 | Fax: (937) 435-3307
www.cesoinc.com

NB US23 - N of HM -Processed
 Northbound US 23
 North of Hills Miller - Delaware, OH

| Start Time | Mon 16-Jun-14 | Tue 17-Jun-14 | Wed 18-Jun-14 | Thu 19-Jun-14 | Fri 20-Jun-14 | Average Day | Sat 21-Jun-14 | Sun 22-Jun-14 | Week Average |
|--------------|------------------|------------------|------------------|------------------|------------------|----------------|------------------|------------------|---|
| 12:00 AM | * | * | 222 | * | * | 222 | * | * | 222  |
| 01:00 | * | * | 214 | * | * | 214 | * | * | 214  |
| 02:00 | * | * | 153 | * | * | 153 | * | * | 153  |
| 03:00 | * | * | 176 | * | * | 176 | * | * | 176  |
| 04:00 | * | * | 256 | * | * | 256 | * | * | 256  |
| 05:00 | * | * | 361 | * | * | 361 | * | * | 361  |
| 06:00 | * | * | 652 | * | * | 652 | * | * | 652  |
| 07:00 | * | * | 924 | * | * | 924 | * | * | 924  |
| 08:00 | * | 920 | 964 | * | * | 942 | * | * | 942  |
| 09:00 | * | 1029 | 984 | * | * | 1006 | * | * | 1006  |
| 10:00 | * | 982 | 740 | * | * | 861 | * | * | 861  |
| 11:00 | * | 1000 | * | * | * | 1000 | * | * | 1000  |
| 12:00 PM | * | 938 | * | * | * | 938 | * | * | 938  |
| 01:00 | * | 1162 | * | * | * | 1162 | * | * | 1162  |
| 02:00 | * | 1169 | * | * | * | 1169 | * | * | 1169  |
| 03:00 | * | 1324 | * | * | * | 1324 | * | * | 1324  |
| 04:00 | * | 1435 | * | * | * | 1435 | * | * | 1435  |
| 05:00 | * | 1317 | * | * | * | 1317 | * | * | 1317  |
| 06:00 | * | 1032 | * | * | * | 1032 | * | * | 1032  |
| 07:00 | * | 814 | * | * | * | 814 | * | * | 814  |
| 08:00 | * | 673 | * | * | * | 673 | * | * | 673  |
| 09:00 | * | 578 | * | * | * | 578 | * | * | 578  |
| 10:00 | * | 400 | * | * | * | 400 | * | * | 400  |
| 11:00 | * | 357 | * | * | * | 357 | * | * | 357  |
| Day Total | 0 | 15130 | 5646 | 0 | 0 | 17966 | 0 | 0 | 17966 |
| % Avg. WkDay | 0.0% | 84.2% | 31.4% | 0.0% | 0.0% | | | | |
| % Avg. Week | 0.0% | 84.2% | 31.4% | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | |
| AM Peak | | 09:00 | 09:00 | | | 09:00 | | | 09:00 |
| Vol. | | 1029 | 984 | | | 1006 | | | 1006 |
| PM Peak | | 16:00 | | | | 16:00 | | | 16:00 |
| Vol. | | 1435 | | | | 1435 | | | 1435 |
| Grand Total | 0 | 15130 | 5646 | 0 | 0 | 17966 | 0 | 0 | 17966 |
| ADT | | ADT 17,466 | | | | AADT 17,466 | | | |

CESO, Inc.
 8534 Yankee Street, Suite 2B
 Dayton, Ohio 45458
 Phone: (937) 435 - 8584 | Fax: (937) 435-3307
www.cesoinc.com

SB US23-Processed
 Southbound US 23
 North of Hills Miller Rd. - Delaware, OH

| Start Time | Mon 16-Jun-14 | Tue 17-Jun-14 | Wed 18-Jun-14 | Thu 19-Jun-14 | Fri 20-Jun-14 | Average Day | Sat 21-Jun-14 | Sun 22-Jun-14 | Week Average | |
|--------------|------------------|------------------|------------------|------------------|------------------|----------------|------------------|------------------|-----------------|-------|
| 12:00 AM | * | * | 154 | * | * | 154 | * | * | 154 | |
| 01:00 | * | * | 138 | * | * | 138 | * | * | 138 | |
| 02:00 | * | * | 150 | * | * | 150 | * | * | 150 | |
| 03:00 | * | * | 250 | * | * | 250 | * | * | 250 | |
| 04:00 | * | * | 440 | * | * | 440 | * | * | 440 | |
| 05:00 | * | * | 902 | * | * | 902 | * | * | 902 | |
| 06:00 | * | * | 1102 | * | * | 1102 | * | * | 1102 | |
| 07:00 | * | 1132 | 1112 | * | * | 1122 | * | * | 1122 | |
| 08:00 | * | 962 | 978 | * | * | 970 | * | * | 970 | |
| 09:00 | * | 936 | 888 | * | * | 912 | * | * | 912 | |
| 10:00 | * | 1020 | * | * | * | 1020 | * | * | 1020 | |
| 11:00 | * | 1056 | * | * | * | 1056 | * | * | 1056 | |
| 12:00 PM | * | 1060 | * | * | * | 1060 | * | * | 1060 | |
| 01:00 | * | 1089 | * | * | * | 1089 | * | * | 1089 | |
| 02:00 | * | 1119 | * | * | * | 1119 | * | * | 1119 | |
| 03:00 | * | 1206 | * | * | * | 1206 | * | * | 1206 | |
| 04:00 | * | 1165 | * | * | * | 1165 | * | * | 1165 | |
| 05:00 | * | 1067 | * | * | * | 1067 | * | * | 1067 | |
| 06:00 | * | 781 | * | * | * | 781 | * | * | 781 | |
| 07:00 | * | 621 | * | * | * | 621 | * | * | 621 | |
| 08:00 | * | 526 | * | * | * | 526 | * | * | 526 | |
| 09:00 | * | 384 | * | * | * | 384 | * | * | 384 | |
| 10:00 | * | 302 | * | * | * | 302 | * | * | 302 | |
| 11:00 | * | 266 | * | * | * | 266 | * | * | 266 | |
| Day Total | 0 | 14692 | 6114 | 0 | 0 | 17802 | 0 | 0 | 17802 | |
| % Avg. WkDay | 0.0% | 82.5% | 34.3% | 0.0% | 0.0% | | | | | |
| % Avg. Week | 0.0% | 82.5% | 34.3% | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | | |
| AM Peak | | 07:00 | 07:00 | | | 07:00 | | | 07:00 | |
| Vol. | | 1132 | 1112 | | | 1122 | | | 1122 | |
| PM Peak | | 15:00 | | | | 15:00 | | | 15:00 | |
| Vol. | | 1206 | | | | 1206 | | | 1206 | |
| Grand Total | | 0 | 14692 | 6114 | 0 | 0 | 17802 | 0 | 0 | 17802 |

ADT

ADT 17,292

AADT 17,292

CESO, Inc.

8534 Yankee Street, Suite 2B
 Dayton, Ohio 45458
 Phone: (937) 435 - 8584 | Fax: (937) 435-3307
www.cesoinc.com

Hills Miller-Processed
 Hills-Miller Road
 West of US 23 - Delaware, OH

| Start Time | 17-Jun-14 Tue | Eastbound | Westbound | Total |
|------------|------------------|------------|------------|------------|
| 12:00 AM | | * | * | * |
| 01:00 | | * | * | * |
| 02:00 | | * | * | * |
| 03:00 | | * | * | * |
| 04:00 | | * | * | * |
| 05:00 | | * | * | * |
| 06:00 | | * | * | * |
| 07:00 | | * | * | * |
| 08:00 | | 142 | 127 | 269 |
| 09:00 | | 132 | 114 | 246 |
| 10:00 | | 112 | 112 | 224 |
| 11:00 | | 152 | 155 | 307 |
| 12:00 PM | | 114 | 111 | 225 |
| 01:00 | | 134 | 146 | 280 |
| 02:00 | | 120 | 152 | 272 |
| 03:00 | | 130 | 186 | 316 |
| 04:00 | | 168 | 228 | 396 |
| 05:00 | | 140 | 226 | 366 |
| 06:00 | | 86 | 150 | 236 |
| 07:00 | | 97 | 144 | 241 |
| 08:00 | | 88 | 102 | 190 |
| 09:00 | | 52 | 72 | 124 |
| 10:00 | | 22 | 46 | 68 |
| 11:00 | | 14 | 26 | 40 |
| Total | | 1703 | 2097 | 3800 |
| Percent | | 44.8% | 55.2% | |
| AM Peak | | 11:00 | 11:00 | 11:00 |
| Vol. | | 152 | 155 | 307 |
| PM Peak | | 16:00 | 16:00 | 16:00 |
| Vol. | | 168 | 228 | 396 |

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Hills Miller-Processed
 Hills-Miller Road
 West of US 23 - Delaware, OH

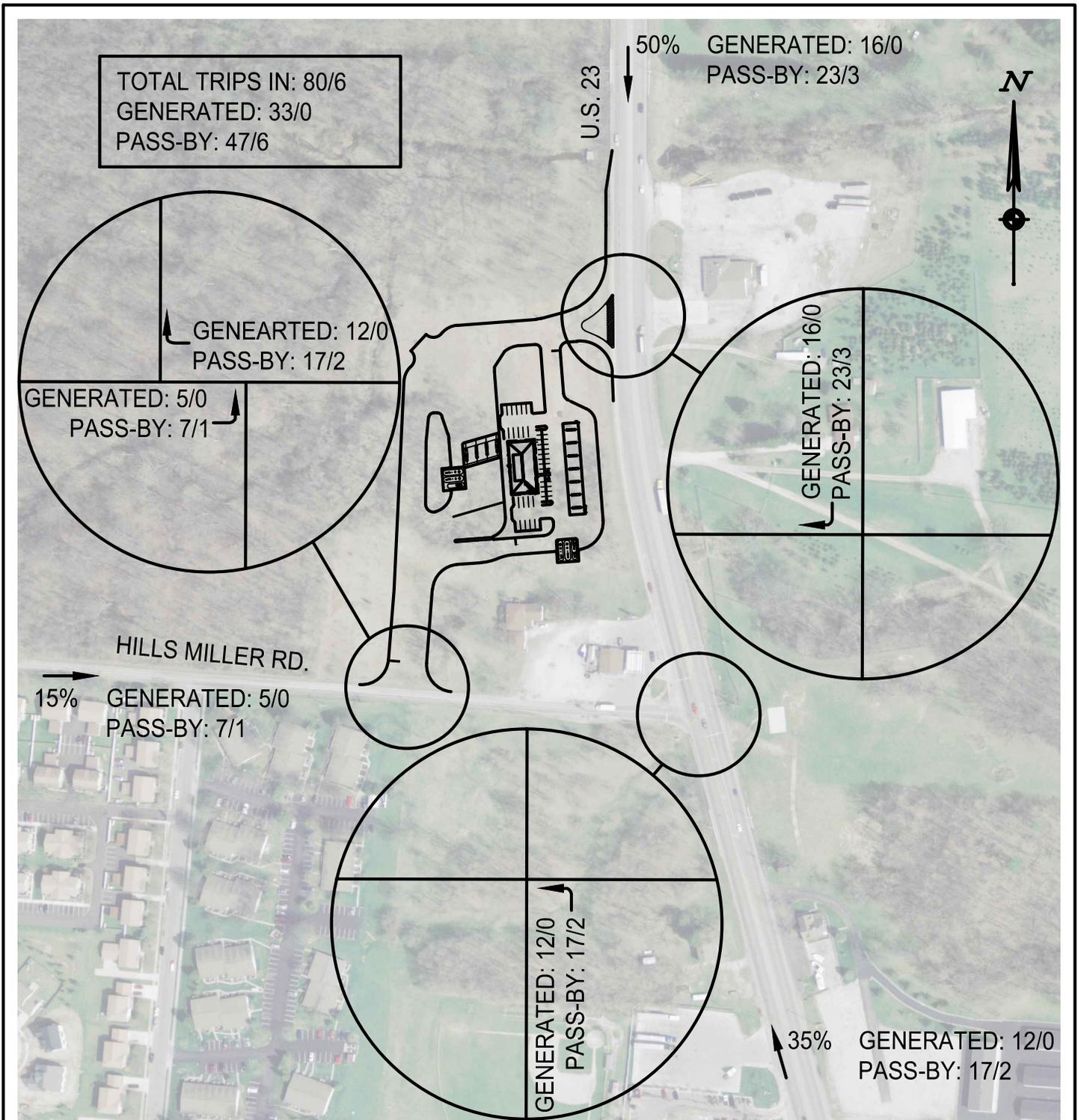
| Start Time | 18-Jun-14 Wed | Eastbound | Westbound | Total |
|-------------|------------------|------------|------------|------------|
| 12:00 AM | | 15 | 14 | 29 |
| 01:00 | | 5 | 4 | 9 |
| 02:00 | | 8 | 6 | 14 |
| 03:00 | | 12 | 4 | 16 |
| 04:00 | | 34 | 20 | 54 |
| 05:00 | | 126 | 48 | 174 |
| 06:00 | | 201 | 106 | 307 |
| 07:00 | | 196 | 126 | 322 |
| 08:00 | | 124 | 84 | 208 |
| 09:00 | | 110 | 107 | 217 |
| 10:00 | | 38 | 36 | 74 |
| 11:00 | | * | * | * |
| 12:00 PM | | * | * | * |
| 01:00 | | * | * | * |
| 02:00 | | * | * | * |
| 03:00 | | * | * | * |
| 04:00 | | * | * | * |
| 05:00 | | * | * | * |
| 06:00 | | * | * | * |
| 07:00 | | * | * | * |
| 08:00 | | * | * | * |
| 09:00 | | * | * | * |
| 10:00 | | * | * | * |
| 11:00 | | * | * | * |
| Total | | 869 | 555 | 1424 |
| Percent | | 61.0% | 39.0% | |
| AM Peak | | 06:00 | 07:00 | 07:00 |
| Vol. | | 201 | 126 | 322 |
| PM Peak | | | | |
| Vol. | | | | |
| Grand Total | | 2572 | 2652 | 5224 |
| Percent | | 49.2% | 50.8% | |
| ADT | | ADT 4,452 | AADT 4,452 | |



**TRIP DISTRIBUTION
FIGURES**

**A
P
P
E
N
D
I
X

B**



AM TRIP DISTRIBUTION IN (CARS/HEAVY TRUCKS)



CREATION TO COMPLETION
 www.cesoinc.com

Engineering • Architecture • Survey • Construction Mgt • Environmental

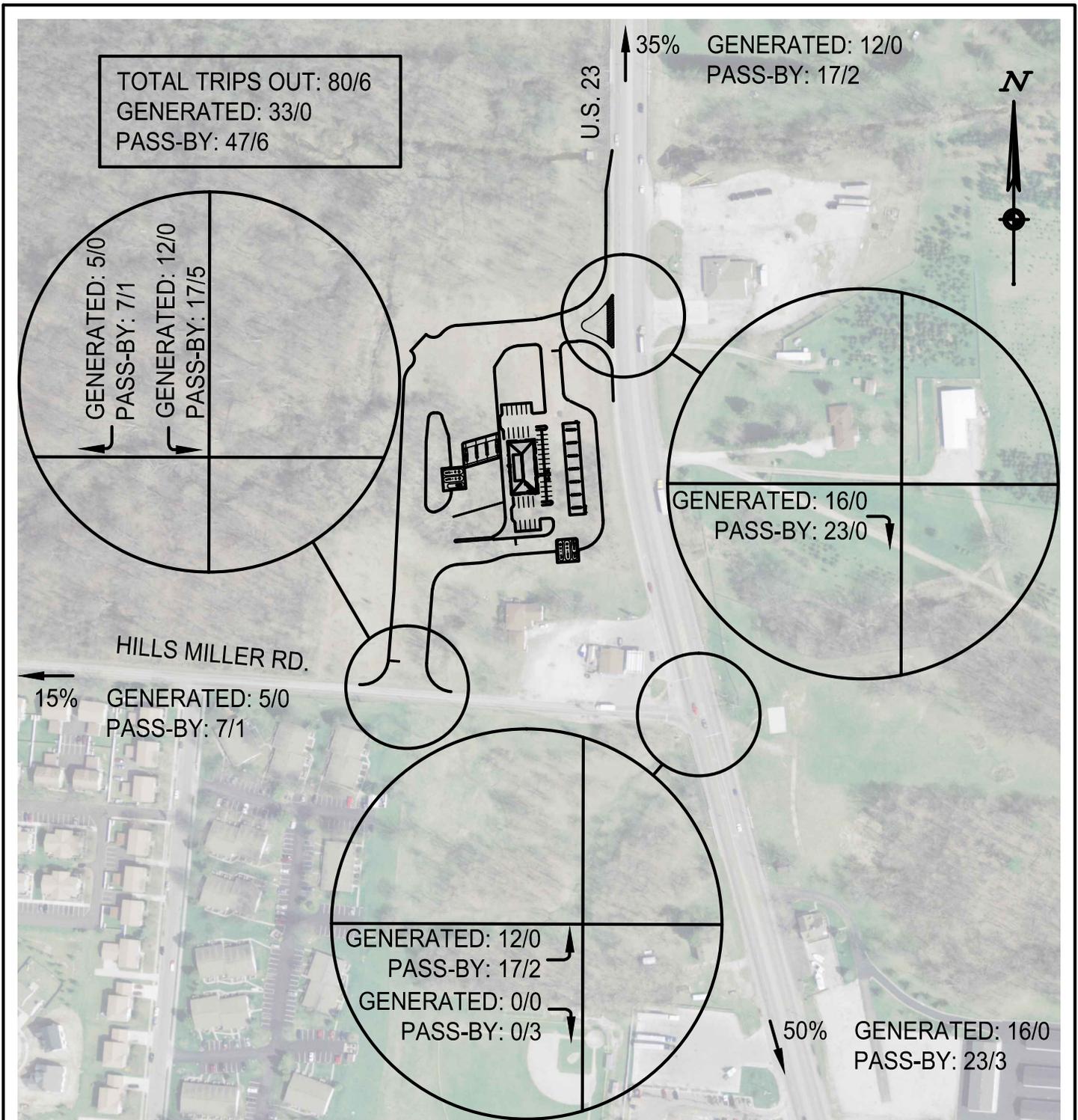
SPEEDWAY #100359
 US HWY 23 & HILLS MILLER RD.
 DELAWARE, OH

JOB NO.: 750421

DESIGN: TJL

DATE: NOV. 2014

FIGURE NO.



AM TRIP DISTRIBUTION OUT (CARS/ HEAVY TRUCKS)



CREATION TO COMPLETION
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Engineering • Architecture • Survey • Construction Mgt • Environmental

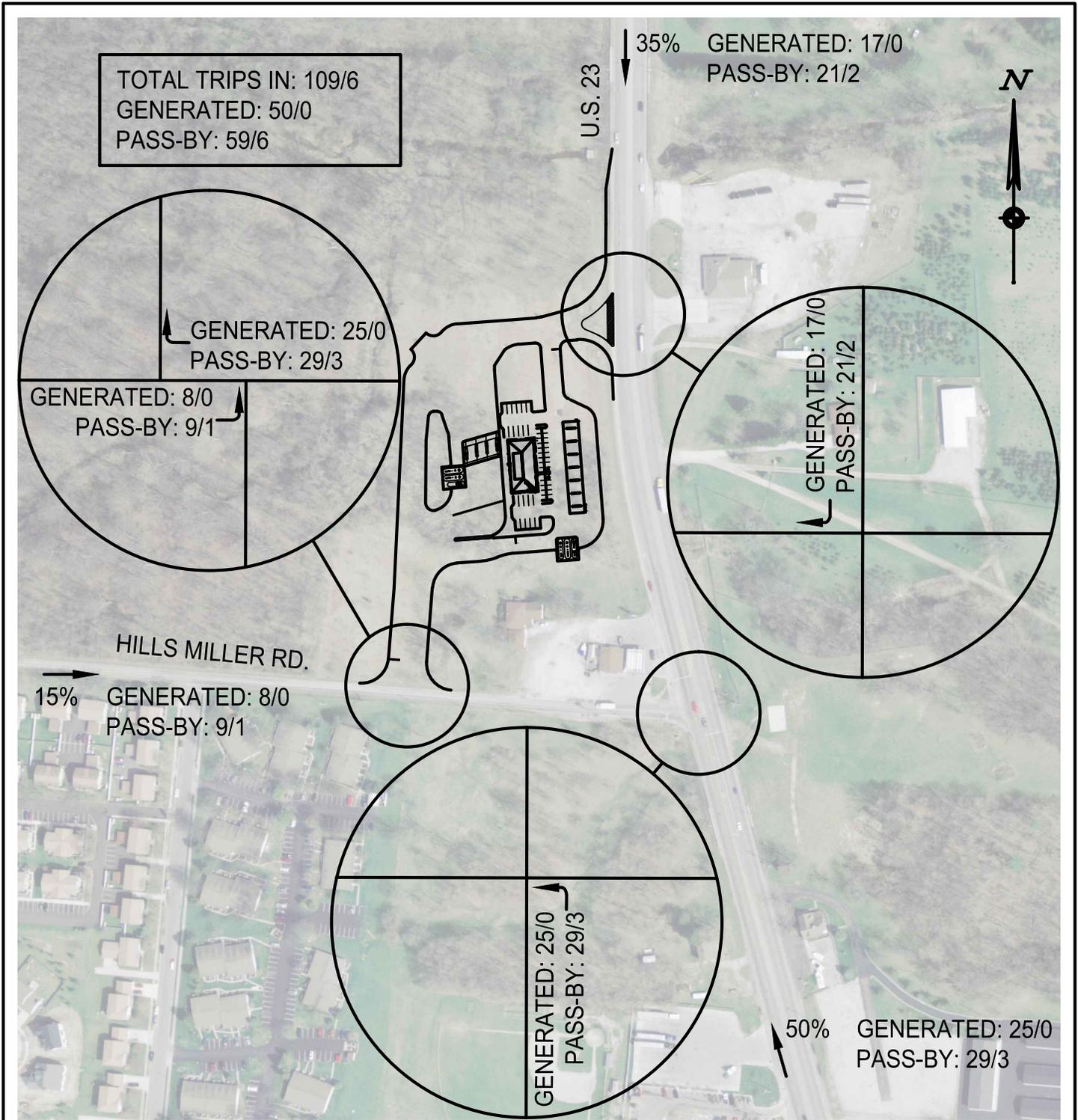
SPEEDWAY #100359
 US HWY 23 & HILLS MILLER RD.
 DELAWARE, OH

JOB NO.: 750421

DESIGN: TJL

DATE: NOV. 2014

FIGURE NO.



PM TRIP DISTRIBUTION IN (CARS/HEAVY TRUCKS)



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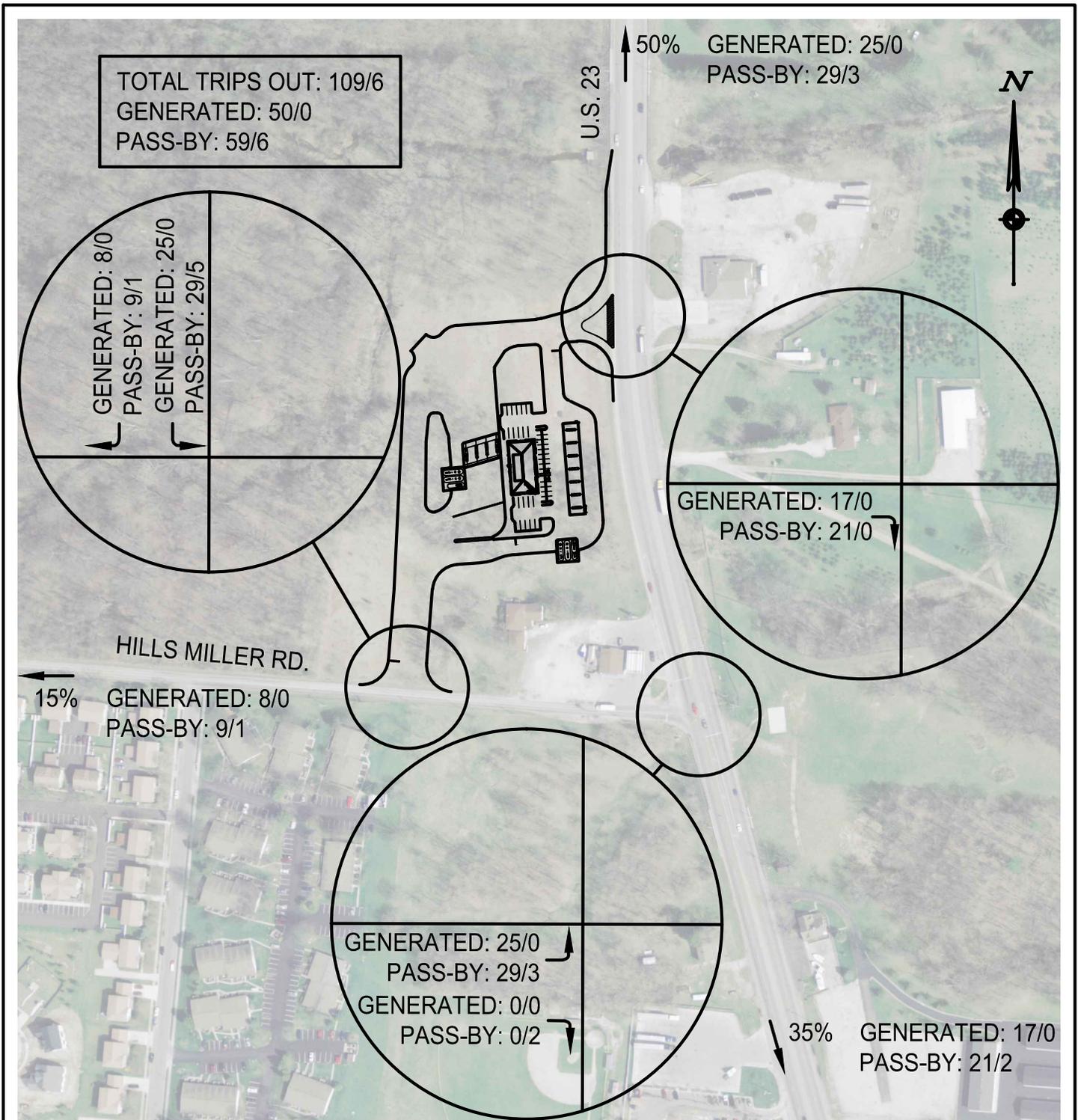
SPEEDWAY #100359
 US HWY 23 & HILLS MILLER RD.
 DELAWARE, OH

JOB NO.: 750421

DESIGN: TJL

DATE: NOV. 2014

FIGURE NO.



PM TRIP DISTRIBUTION OUT (CARS/ HEAVY TRUCKS)



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SPEEDWAY #100359
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 DELAWARE, OH

JOB NO.: 750421

DESIGN: TJL

DATE: NOV. 2014

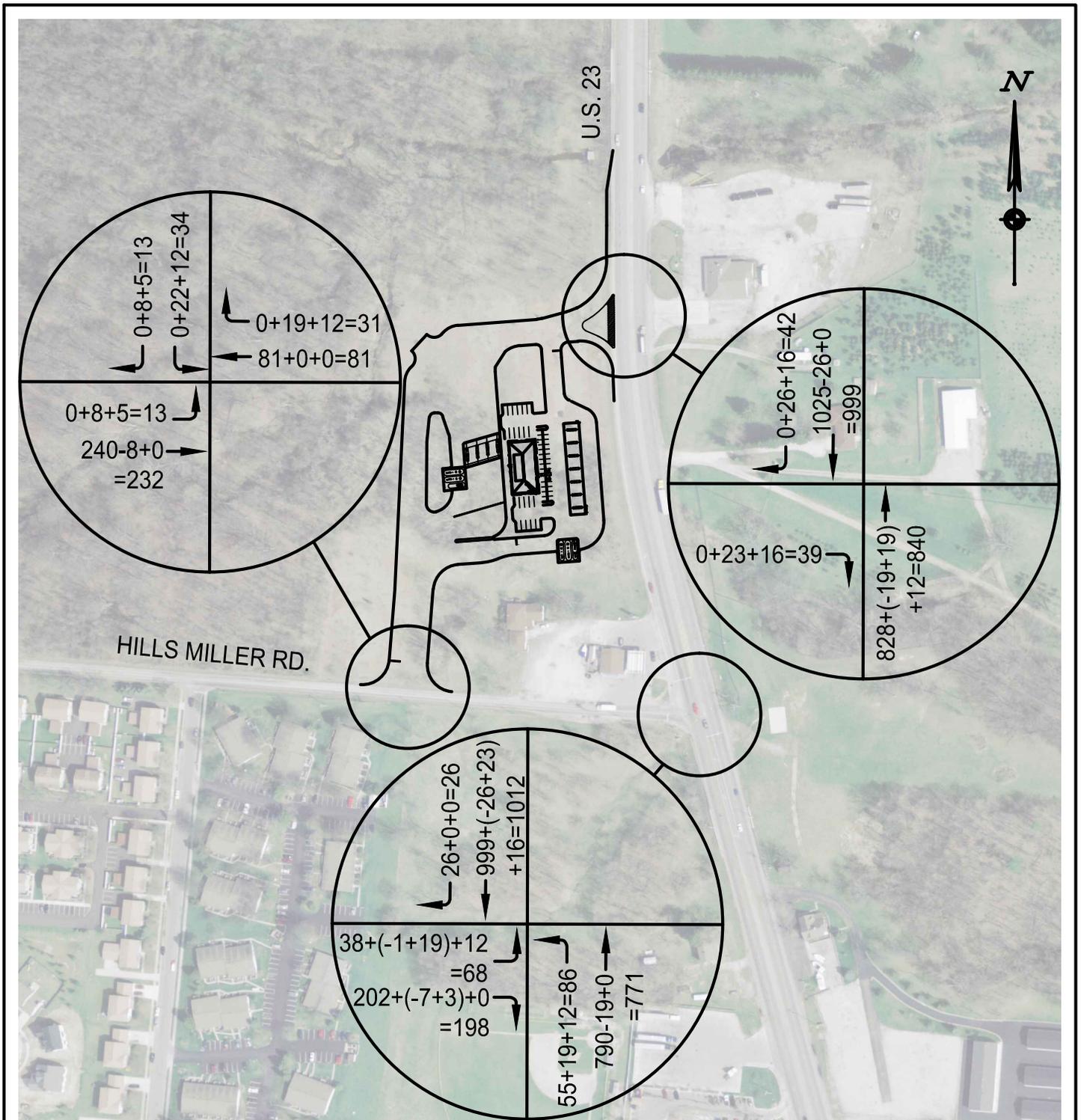
FIGURE NO.



**TRAFFIC VOLUMES
2015 A.M. PEAK**

**A
P
P
E
N
D
I
X

C**



2015 AM
 BACKGROUND + PASS-BY + SITE GENERATED = TOTAL PEAK VOLUME



Engineering • Architecture • Survey • Construction Mgt • Environmental

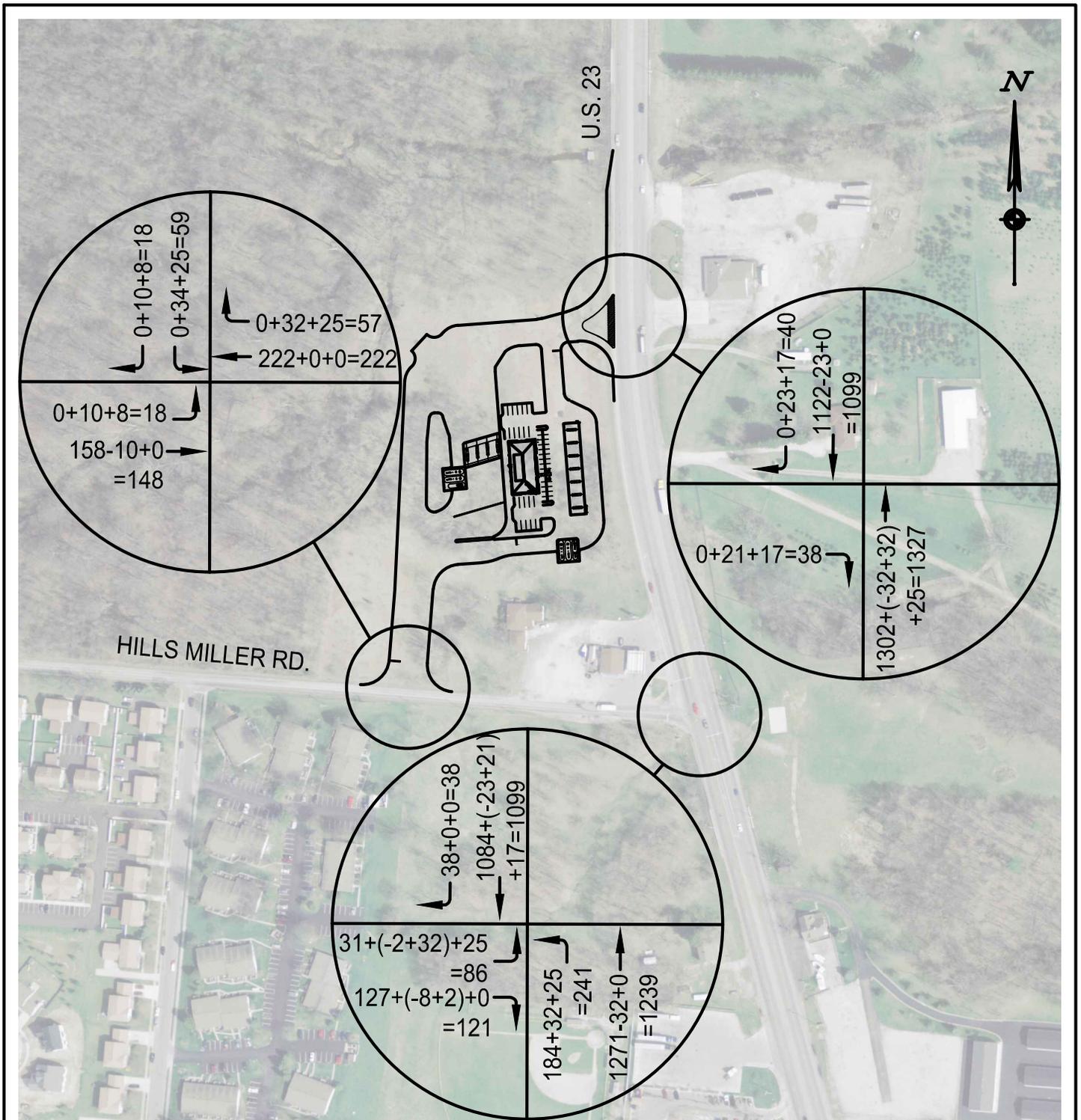
SPEEDWAY #100359
 US HWY 23 & HILLS MILLER RD.
 DELAWARE, OH

| | |
|------------|-----------|
| JOB NO.: | 750421 |
| DESIGN: | TJL |
| DATE: | NOV. 2014 |
| FIGURE NO. | |



**TRAFFIC VOLUMES
2015 P.M. PEAK**

**A
P
P
E
N
D
I
X
D**



2015 PM

BACKGROUND + PASS-BY + SITE GENERATED = TOTAL PEAK VOLUME



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DESIGN: TJL

DATE: NOV. 2014

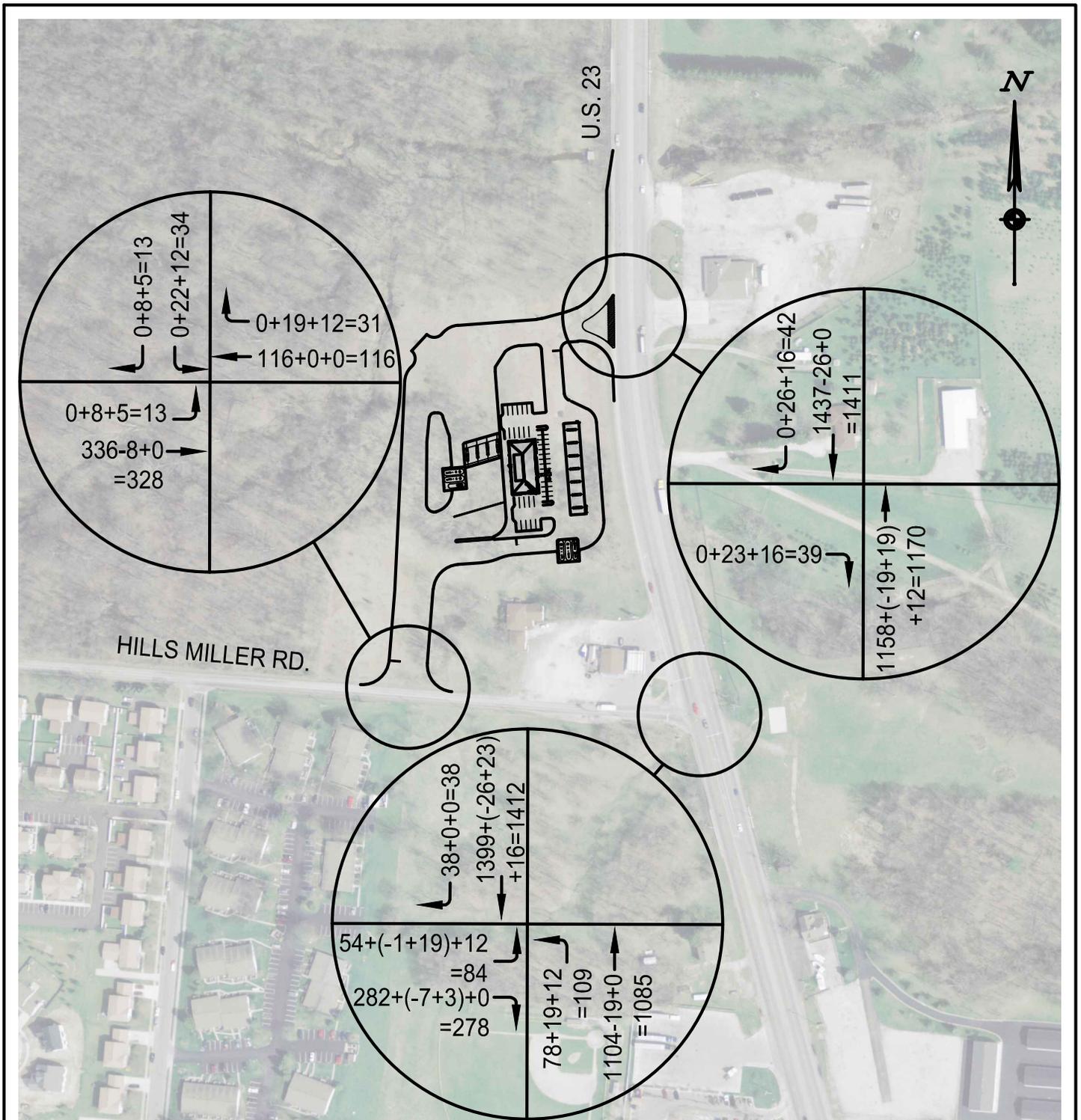
FIGURE NO.



**TRAFFIC VOLUMES
2035 A.M. PEAK**

**A
P
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X

E**



2035 AM

BACKGROUND + PASS-BY + SITE GENERATED = TOTAL PEAK VOLUME



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SPEEDWAY #100359
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DELAWARE, OH

JOB NO.: 750421

DESIGN: TJL

DATE: NOV. 2014

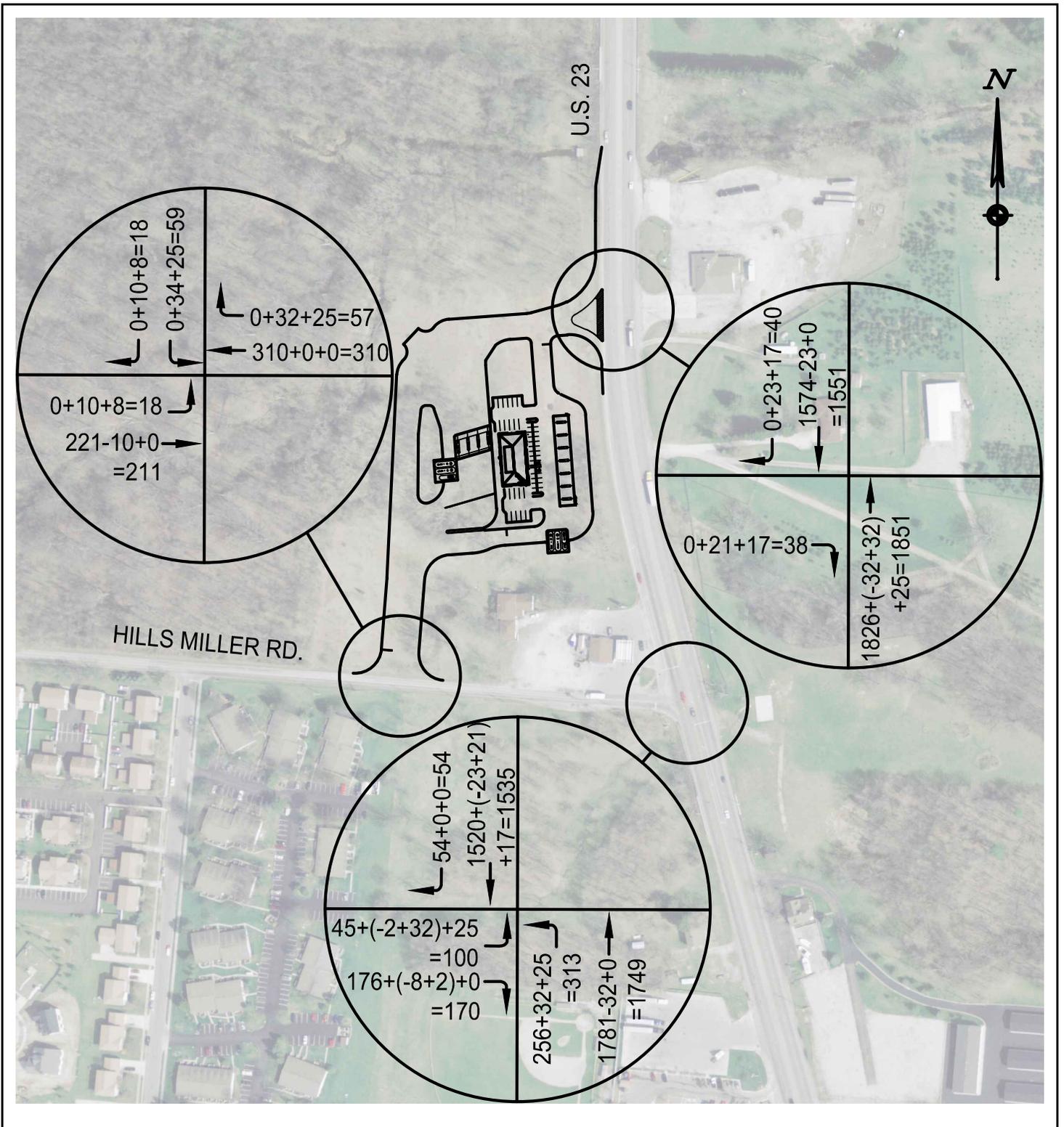
FIGURE NO.



TRAFFIC VOLUMES
2035 P.M. PEAK

**A
P
P
E
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D
I
X

F**



2035 PM

BACKGROUND + PASS-BY + SITE GENERATED = TOTAL PEAK VOLUME



Engineering • Architecture • Survey • Construction Mgt • Environmental

SPEEDWAY #100359
US HWY 23 & HILLS MILLER RD.
DELAWARE, OH

JOB NO.: 750421

DESIGN: TJL

DATE: NOV. 2014

FIGURE NO.



**SYNCHRO
ANALYSIS
2015
AM PEAK
BACKGROUND
CONDITION**

**A
P
P
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N
D
I
X
G**

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 38 | 202 | 55 | 790 | 999 | 26 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (ft) | 11 | 12 | 10 | 12 | 12 | 12 |
| Storage Length (ft) | 0 | 0 | 245 | | | 230 |
| Storage Lanes | 1 | 0 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | 0.886 | | | | | 0.850 |
| Flt Protected | 0.992 | | 0.950 | | | |
| Satd. Flow (prot) | 1583 | 0 | 1652 | 3282 | 3282 | 1583 |
| Flt Permitted | 0.992 | | 0.150 | | | |
| Satd. Flow (perm) | 1583 | 0 | 261 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | 193 | | | | | 28 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 1023 | | | 413 | 393 | |
| Travel Time (s) | 19.9 | | | 6.3 | 6.0 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 41 | 220 | 60 | 859 | 1086 | 28 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 261 | 0 | 60 | 859 | 1086 | 28 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 11 | | | 10 | 10 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.04 | 1.00 | 1.09 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 2 | | 1 | 2 | 2 | 1 |
| Detector Template | | | | | Thru | Right |
| Leading Detector (ft) | 100 | | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 6 | | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | 94 | | | 94 | 94 | |
| Detector 2 Size(ft) | 6 | | | 6 | 6 | |
| Detector 2 Type | Cl+Ex | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | 0.0 | | | 0.0 | 0.0 | |
| Turn Type | NA | | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-----|-------|-------|-------|-------|
| Permitted Phases | | | 2 | | | 6 |
| Detector Phase | 4 | | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 7.0 | | 4.0 | 20.0 | 20.0 | 20.0 |
| Minimum Split (s) | 13.0 | | 10.0 | 26.0 | 26.0 | 26.0 |
| Total Split (s) | 23.0 | | 12.0 | 57.0 | 45.0 | 45.0 |
| Total Split (%) | 28.8% | | 15.0% | 71.3% | 56.3% | 56.3% |
| Maximum Green (s) | 17.0 | | 6.0 | 51.0 | 39.0 | 39.0 |
| Yellow Time (s) | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | | None | Min | Min | Min |
| Act Effct Green (s) | 10.0 | | 33.7 | 33.7 | 27.7 | 27.7 |
| Actuated g/C Ratio | 0.18 | | 0.59 | 0.59 | 0.49 | 0.49 |
| v/c Ratio | 0.60 | | 0.19 | 0.44 | 0.68 | 0.04 |
| Control Delay | 14.7 | | 6.2 | 6.8 | 15.0 | 4.6 |
| Queue Delay | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 14.7 | | 6.2 | 6.8 | 15.0 | 4.6 |
| LOS | B | | A | A | B | A |
| Approach Delay | 14.7 | | | 6.8 | 14.8 | |
| Approach LOS | B | | | A | B | |
| Queue Length 50th (ft) | 22 | | 6 | 61 | 156 | 0 |
| Queue Length 95th (ft) | 96 | | 23 | 131 | 276 | 12 |
| Internal Link Dist (ft) | 943 | | | 333 | 313 | |
| Turn Bay Length (ft) | | | 245 | | | 230 |
| Base Capacity (vph) | 644 | | 314 | 2796 | 2447 | 1187 |
| Starvation Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.41 | | 0.19 | 0.31 | 0.44 | 0.02 |

Intersection Summary

| | |
|------------------------------------|------------------------|
| Area Type: | Other |
| Cycle Length: | 80 |
| Actuated Cycle Length: | 56.8 |
| Natural Cycle: | 55 |
| Control Type: | Actuated-Uncoordinated |
| Maximum v/c Ratio: | 0.68 |
| Intersection Signal Delay: | 11.6 |
| Intersection LOS: | B |
| Intersection Capacity Utilization: | 60.5% |
| ICU Level of Service: | B |
| Analysis Period (min): | 15 |

2:

Splits and Phases: 2:





**SYNCHRO
ANALYSIS
2015
PM PEAK
BACKGROUND
CONDITION**

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| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 31 | 127 | 184 | 1271 | 1084 | 38 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (ft) | 11 | 12 | 10 | 12 | 12 | 12 |
| Storage Length (ft) | 0 | 0 | 245 | | | 230 |
| Storage Lanes | 1 | 0 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | 0.892 | | | | | 0.850 |
| Flt Protected | 0.990 | | 0.950 | | | |
| Satd. Flow (prot) | 1590 | 0 | 1652 | 3282 | 3282 | 1583 |
| Flt Permitted | 0.990 | | 0.120 | | | |
| Satd. Flow (perm) | 1590 | 0 | 209 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | 138 | | | | | 41 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 1023 | | | 413 | 1148 | |
| Travel Time (s) | 19.9 | | | 6.3 | 17.4 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 34 | 138 | 200 | 1382 | 1178 | 41 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 172 | 0 | 200 | 1382 | 1178 | 41 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 11 | | | 10 | 10 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.04 | 1.00 | 1.09 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 1 | | 1 | 2 | 2 | 1 |
| Detector Template | | | | | Thru | Right |
| Leading Detector (ft) | 20 | | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 20 | | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | | | | 94 | 94 | |
| Detector 2 Size(ft) | | | | 6 | 6 | |
| Detector 2 Type | | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | | | 0.0 | 0.0 | |
| Turn Type | NA | | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-----|-------|-------|-------|-------|
| Permitted Phases | | | 2 | | | 6 |
| Detector Phase | 4 | | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 7.0 | | 4.0 | 20.0 | 20.0 | 20.0 |
| Minimum Split (s) | 13.0 | | 10.0 | 26.0 | 26.0 | 26.0 |
| Total Split (s) | 18.0 | | 14.0 | 72.0 | 58.0 | 58.0 |
| Total Split (%) | 20.0% | | 15.6% | 80.0% | 64.4% | 64.4% |
| Maximum Green (s) | 12.0 | | 8.0 | 66.0 | 52.0 | 52.0 |
| Yellow Time (s) | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | | None | Min | Min | Min |
| Act Effect Green (s) | 8.3 | | 44.2 | 44.2 | 30.1 | 30.1 |
| Actuated g/C Ratio | 0.13 | | 0.68 | 0.68 | 0.47 | 0.47 |
| v/c Ratio | 0.53 | | 0.62 | 0.62 | 0.77 | 0.05 |
| Control Delay | 15.6 | | 18.5 | 7.1 | 18.3 | 3.5 |
| Queue Delay | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 15.6 | | 18.5 | 7.1 | 18.3 | 3.5 |
| LOS | B | | B | A | B | A |
| Approach Delay | 15.6 | | | 8.5 | 17.8 | |
| Approach LOS | B | | | A | B | |
| Queue Length 50th (ft) | 12 | | 21 | 113 | 181 | 0 |
| Queue Length 95th (ft) | 70 | | #115 | 209 | 286 | 14 |
| Internal Link Dist (ft) | 943 | | | 333 | 1068 | |
| Turn Bay Length (ft) | | | 245 | | | 230 |
| Base Capacity (vph) | 412 | | 324 | 3146 | 2687 | 1303 |
| Starvation Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.42 | | 0.62 | 0.44 | 0.44 | 0.03 |

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 64.7
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.77
 Intersection Signal Delay: 12.7
 Intersection LOS: B
 Intersection Capacity Utilization 64.7%
 ICU Level of Service C
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.

2:

Queue shown is maximum after two cycles.

Splits and Phases: 2:





**SYNCHRO
ANALYSIS
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2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 68 | 198 | 86 | 771 | 1012 | 26 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (ft) | 11 | 12 | 10 | 12 | 12 | 12 |
| Storage Length (ft) | 0 | 0 | 245 | | | 230 |
| Storage Lanes | 1 | 0 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | 0.900 | | | | | 0.850 |
| Flt Protected | 0.987 | | 0.950 | | | |
| Satd. Flow (prot) | 1568 | 0 | 1532 | 3282 | 3282 | 1583 |
| Flt Permitted | 0.987 | | 0.137 | | | |
| Satd. Flow (perm) | 1568 | 0 | 221 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | 145 | | | | | 28 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 517 | | | 413 | 720 | |
| Travel Time (s) | 10.1 | | | 6.3 | 10.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 10% | 2% | 10% | 10% | 10% | 2% |
| Adj. Flow (vph) | 74 | 215 | 93 | 838 | 1100 | 28 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 289 | 0 | 93 | 838 | 1100 | 28 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 11 | | | 10 | 10 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.04 | 1.00 | 1.09 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 1 | | 1 | 2 | 2 | 1 |
| Detector Template | | | | | Thru | Right |
| Leading Detector (ft) | 20 | | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 20 | | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | | | | 94 | 94 | |
| Detector 2 Size(ft) | | | | 6 | 6 | |
| Detector 2 Type | | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | | | 0.0 | 0.0 | |
| Turn Type | NA | | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-----|-------|-------|-------|-------|
| Permitted Phases | | | 2 | | | 6 |
| Detector Phase | 4 | | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 7.0 | | 4.0 | 20.0 | 20.0 | 20.0 |
| Minimum Split (s) | 13.0 | | 10.0 | 26.0 | 26.0 | 26.0 |
| Total Split (s) | 33.0 | | 10.0 | 47.0 | 37.0 | 37.0 |
| Total Split (%) | 41.3% | | 12.5% | 58.8% | 46.3% | 46.3% |
| Maximum Green (s) | 27.0 | | 4.0 | 41.0 | 31.0 | 31.0 |
| Yellow Time (s) | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | | None | Min | Min | Min |
| Act Effct Green (s) | 12.1 | | 34.6 | 34.6 | 27.2 | 27.2 |
| Actuated g/C Ratio | 0.20 | | 0.58 | 0.58 | 0.46 | 0.46 |
| v/c Ratio | 0.67 | | 0.42 | 0.44 | 0.73 | 0.04 |
| Control Delay | 20.2 | | 12.0 | 8.0 | 18.0 | 5.2 |
| Queue Delay | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 20.2 | | 12.0 | 8.0 | 18.0 | 5.2 |
| LOS | C | | B | A | B | A |
| Approach Delay | 20.2 | | | 8.4 | 17.6 | |
| Approach LOS | C | | | A | B | |
| Queue Length 50th (ft) | 49 | | 12 | 73 | 167 | 0 |
| Queue Length 95th (ft) | 124 | | 38 | 146 | 294 | 13 |
| Internal Link Dist (ft) | 437 | | | 333 | 640 | |
| Turn Bay Length (ft) | | | 245 | | | 230 |
| Base Capacity (vph) | 825 | | 221 | 2348 | 1800 | 881 |
| Starvation Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.35 | | 0.42 | 0.36 | 0.61 | 0.03 |

Intersection Summary

| | |
|------------------------------------|------------------------|
| Area Type: | Other |
| Cycle Length: | 80 |
| Actuated Cycle Length: | 59.3 |
| Natural Cycle: | 55 |
| Control Type: | Actuated-Uncoordinated |
| Maximum v/c Ratio: | 0.73 |
| Intersection Signal Delay: | 14.3 |
| Intersection LOS: | B |
| Intersection Capacity Utilization: | 63.7% |
| ICU Level of Service: | B |
| Analysis Period (min): | 15 |

Splits and Phases: 2:



6:

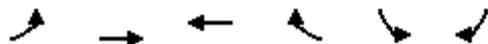


| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|------|-------|------|------|------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 0 | 39 | 0 | 840 | 999 | 42 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (ft) | 0 | 0 | 0 | | | 235 |
| Storage Lanes | 0 | 1 | 0 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | | 0.865 | | | | 0.850 |
| Flt Protected | | | | | | |
| Satd. Flow (prot) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Flt Permitted | | | | | | |
| Satd. Flow (perm) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Link Speed (mph) | 30 | | | 30 | 45 | |
| Link Distance (ft) | 139 | | | 720 | 506 | |
| Travel Time (s) | 3.2 | | | 16.4 | 7.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 0 | 42 | 0 | 913 | 1086 | 46 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 42 | 0 | 913 | 1086 | 46 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 0 | | | 0 | 0 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Sign Control | Stop | | | Free | Free | |

Intersection Summary

| | |
|-----------------------------------|------------------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 37.6% |
| Analysis Period (min) | 15 |
| | ICU Level of Service A |

8:



| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|----------------------------|------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 13 | 232 | 81 | 31 | 34 | 13 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.962 | | 0.963 | |
| Flt Protected | | 0.997 | | | 0.965 | |
| Satd. Flow (prot) | 0 | 1857 | 1792 | 0 | 1731 | 0 |
| Flt Permitted | | 0.997 | | | 0.965 | |
| Satd. Flow (perm) | 0 | 1857 | 1792 | 0 | 1731 | 0 |
| Link Speed (mph) | | 35 | 30 | | 30 | |
| Link Distance (ft) | | 525 | 517 | | 157 | |
| Travel Time (s) | | 10.2 | 11.8 | | 3.6 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 14 | 252 | 88 | 34 | 37 | 14 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 266 | 122 | 0 | 51 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(ft) | | 0 | 0 | | 12 | |
| Link Offset(ft) | | 0 | 0 | | 0 | |
| Crosswalk Width(ft) | | 16 | 16 | | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | | | 9 | 15 | 9 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

| | |
|-----------------------------------|--------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 29.6% |
| ICU Level of Service | A |
| Analysis Period (min) | 15 |

Queuing and Blocking Report

5/6/2015

Intersection: 2:

| Movement | EB | NB | NB | NB | SB | SB |
|-----------------------|-----|-----|-----|-----|-----|-----|
| Directions Served | LR | L | T | T | T | T |
| Maximum Queue (ft) | 214 | 55 | 137 | 113 | 220 | 162 |
| Average Queue (ft) | 99 | 33 | 85 | 52 | 155 | 116 |
| 95th Queue (ft) | 202 | 65 | 143 | 104 | 231 | 176 |
| Link Distance (ft) | 408 | | 397 | 397 | 640 | 640 |
| Upstream Blk Time (%) | | | | | | |
| Queuing Penalty (veh) | | | | | | |
| Storage Bay Dist (ft) | | 245 | | | | |
| Storage Blk Time (%) | | | | | | |
| Queuing Penalty (veh) | | | | | | |

Intersection: 6:

| Movement | EB |
|-----------------------|----|
| Directions Served | R |
| Maximum Queue (ft) | 19 |
| Average Queue (ft) | 15 |
| 95th Queue (ft) | 27 |
| Link Distance (ft) | 81 |
| Upstream Blk Time (%) | |
| Queuing Penalty (veh) | |
| Storage Bay Dist (ft) | |
| Storage Blk Time (%) | |
| Queuing Penalty (veh) | |

Intersection: 8:

| Movement | EB | SB |
|-----------------------|-----|-----|
| Directions Served | LT | LR |
| Maximum Queue (ft) | 53 | 77 |
| Average Queue (ft) | 17 | 44 |
| 95th Queue (ft) | 52 | 76 |
| Link Distance (ft) | 501 | 126 |
| Upstream Blk Time (%) | | |
| Queuing Penalty (veh) | | |
| Storage Bay Dist (ft) | | |
| Storage Blk Time (%) | | |
| Queuing Penalty (veh) | | |

Network Summary

Network wide Queuing Penalty: 0



**SYNCHRO
ANALYSIS
2015
PM PEAK
BUILD CONDITION**

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2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 86 | 121 | 241 | 1239 | 1099 | 38 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (ft) | 11 | 12 | 10 | 12 | 12 | 12 |
| Storage Length (ft) | 0 | 0 | 245 | | | 230 |
| Storage Lanes | 1 | 0 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | 0.921 | | | | | 0.850 |
| Flt Protected | 0.980 | | 0.950 | | | |
| Satd. Flow (prot) | 1574 | 0 | 1532 | 3282 | 3282 | 1583 |
| Flt Permitted | 0.980 | | 0.103 | | | |
| Satd. Flow (perm) | 1574 | 0 | 166 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | 75 | | | | | 41 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 517 | | | 413 | 720 | |
| Travel Time (s) | 10.1 | | | 6.3 | 10.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 10% | 2% | 10% | 10% | 10% | 2% |
| Adj. Flow (vph) | 93 | 132 | 262 | 1347 | 1195 | 41 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 225 | 0 | 262 | 1347 | 1195 | 41 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 11 | | | 10 | 10 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.04 | 1.00 | 1.09 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 1 | | 1 | 2 | 2 | 1 |
| Detector Template | | | | | Thru | Right |
| Leading Detector (ft) | 20 | | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 20 | | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | | | | 94 | 94 | |
| Detector 2 Size(ft) | | | | 6 | 6 | |
| Detector 2 Type | | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | | | 0.0 | 0.0 | |
| Turn Type | NA | | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-----|-------|-------|-------|-------|
| Permitted Phases | | | 2 | | | 6 |
| Detector Phase | 4 | | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 7.0 | | 4.0 | 20.0 | 20.0 | 20.0 |
| Minimum Split (s) | 13.0 | | 10.0 | 26.0 | 26.0 | 26.0 |
| Total Split (s) | 28.0 | | 19.0 | 62.0 | 43.0 | 43.0 |
| Total Split (%) | 31.1% | | 21.1% | 68.9% | 47.8% | 47.8% |
| Maximum Green (s) | 22.0 | | 13.0 | 56.0 | 37.0 | 37.0 |
| Yellow Time (s) | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | | None | Min | Min | Min |
| Act Effct Green (s) | 13.2 | | 52.1 | 52.1 | 32.8 | 32.8 |
| Actuated g/C Ratio | 0.17 | | 0.67 | 0.67 | 0.42 | 0.42 |
| v/c Ratio | 0.68 | | 0.76 | 0.61 | 0.86 | 0.06 |
| Control Delay | 31.3 | | 34.1 | 9.2 | 28.6 | 5.4 |
| Queue Delay | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 31.3 | | 34.1 | 9.2 | 28.6 | 5.4 |
| LOS | C | | C | A | C | A |
| Approach Delay | 31.3 | | | 13.3 | 27.8 | |
| Approach LOS | C | | | B | C | |
| Queue Length 50th (ft) | 71 | | 77 | 161 | 263 | 0 |
| Queue Length 95th (ft) | 144 | | #232 | 294 | #447 | 19 |
| Internal Link Dist (ft) | 437 | | | 333 | 640 | |
| Turn Bay Length (ft) | | | 245 | | | 230 |
| Base Capacity (vph) | 507 | | 344 | 2412 | 1593 | 789 |
| Starvation Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.44 | | 0.76 | 0.56 | 0.75 | 0.05 |

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 77.5
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.86
 Intersection Signal Delay: 20.4
 Intersection LOS: C
 Intersection Capacity Utilization 70.9%
 ICU Level of Service C
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2:



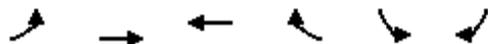
6:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|------|-------|------|------|------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 0 | 38 | 0 | 1327 | 1099 | 40 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (ft) | 0 | 0 | 0 | | | 235 |
| Storage Lanes | 0 | 1 | 0 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | | 0.865 | | | | 0.850 |
| Flt Protected | | | | | | |
| Satd. Flow (prot) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Flt Permitted | | | | | | |
| Satd. Flow (perm) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Link Speed (mph) | 30 | | | 30 | 45 | |
| Link Distance (ft) | 139 | | | 720 | 506 | |
| Travel Time (s) | 3.2 | | | 16.4 | 7.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 0 | 41 | 0 | 1442 | 1195 | 43 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 41 | 0 | 1442 | 1195 | 43 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 0 | | | 0 | 0 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Sign Control | Stop | | | Free | Free | |

Intersection Summary

| | |
|-----------------------------------|--------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 40.4% |
| ICU Level of Service | A |
| Analysis Period (min) | 15 |



| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|----------------------------|------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 18 | 148 | 222 | 57 | 59 | 18 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.972 | | 0.968 | |
| Flt Protected | | 0.995 | | | 0.963 | |
| Satd. Flow (prot) | 0 | 1853 | 1811 | 0 | 1736 | 0 |
| Flt Permitted | | 0.995 | | | 0.963 | |
| Satd. Flow (perm) | 0 | 1853 | 1811 | 0 | 1736 | 0 |
| Link Speed (mph) | | 35 | 30 | | 30 | |
| Link Distance (ft) | | 525 | 517 | | 157 | |
| Travel Time (s) | | 10.2 | 11.8 | | 3.6 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 20 | 161 | 241 | 62 | 64 | 20 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 181 | 303 | 0 | 84 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(ft) | | 0 | 0 | | 12 | |
| Link Offset(ft) | | 0 | 0 | | 0 | |
| Crosswalk Width(ft) | | 16 | 16 | | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | | | 9 | 15 | 9 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

| | |
|-----------------------------------|------------------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 33.9% |
| Analysis Period (min) | 15 |
| | ICU Level of Service A |

Queuing and Blocking Report

5/6/2015

Intersection: 2:

| Movement | EB | NB | NB | NB | SB | SB | SB |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|
| Directions Served | LR | L | T | T | T | T | R |
| Maximum Queue (ft) | 106 | 113 | 196 | 181 | 218 | 206 | 31 |
| Average Queue (ft) | 63 | 84 | 126 | 103 | 160 | 139 | 11 |
| 95th Queue (ft) | 101 | 124 | 199 | 185 | 263 | 257 | 35 |
| Link Distance (ft) | 408 | | 397 | 397 | 640 | 640 | |
| Upstream Blk Time (%) | | | | | | | |
| Queuing Penalty (veh) | | | | | | | |
| Storage Bay Dist (ft) | | 245 | | | | | 230 |
| Storage Blk Time (%) | | | | | | | |
| Queuing Penalty (veh) | | | | | | | |

Intersection: 6:

| Movement | EB |
|-----------------------|----|
| Directions Served | R |
| Maximum Queue (ft) | 43 |
| Average Queue (ft) | 17 |
| 95th Queue (ft) | 52 |
| Link Distance (ft) | 81 |
| Upstream Blk Time (%) | |
| Queuing Penalty (veh) | |
| Storage Bay Dist (ft) | |
| Storage Blk Time (%) | |
| Queuing Penalty (veh) | |

Intersection: 8:

| Movement | EB | SB |
|-----------------------|-----|-----|
| Directions Served | LT | LR |
| Maximum Queue (ft) | 31 | 54 |
| Average Queue (ft) | 6 | 34 |
| 95th Queue (ft) | 26 | 51 |
| Link Distance (ft) | 501 | 126 |
| Upstream Blk Time (%) | | |
| Queuing Penalty (veh) | | |
| Storage Bay Dist (ft) | | |
| Storage Blk Time (%) | | |
| Queuing Penalty (veh) | | |

Network Summary

Network wide Queuing Penalty: 0



SYNCHRO ANALYSIS
2015 PM PEAK
BUILD CONDITION
- WITH
IMPROVEMENTS

**A
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K**

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 86 | 121 | 241 | 1239 | 1099 | 38 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (ft) | 0 | 211 | 245 | | | 230 |
| Storage Lanes | 1 | 1 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Fr _t | | 0.850 | | | | 0.850 |
| Fl _t Protected | 0.950 | | 0.950 | | | |
| Satd. Flow (prot) | 1641 | 1583 | 1641 | 3282 | 3282 | 1583 |
| Fl _t Permitted | 0.950 | | 0.129 | | | |
| Satd. Flow (perm) | 1641 | 1583 | 223 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | | 132 | | | | 37 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 517 | | | 413 | 720 | |
| Travel Time (s) | 10.1 | | | 6.3 | 10.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 10% | 2% | 10% | 10% | 10% | 2% |
| Adj. Flow (vph) | 93 | 132 | 262 | 1347 | 1195 | 41 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 93 | 132 | 262 | 1347 | 1195 | 41 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 12 | | | 12 | 12 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 1 | 1 | 1 | 2 | 2 | 1 |
| Detector Template | | Right | | | Thru | Right |
| Leading Detector (ft) | 20 | 20 | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | 0 | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | 0 | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 20 | 20 | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | | | | 94 | 94 | |
| Detector 2 Size(ft) | | | | 6 | 6 | |
| Detector 2 Type | | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | | | 0.0 | 0.0 | |
| Turn Type | NA | Perm | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |
| Permitted Phases | | 4 | 2 | | | 6 |

2:



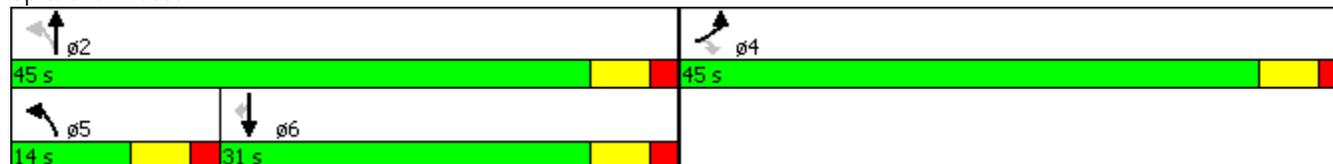
| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-------|-------|-------|-------|-------|
| Detector Phase | 4 | 4 | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 5.0 | 5.0 | 6.0 | 20.0 | 20.0 | 20.0 |
| Minimum Split (s) | 11.0 | 11.0 | 12.0 | 26.0 | 26.0 | 26.0 |
| Total Split (s) | 45.0 | 45.0 | 14.0 | 45.0 | 31.0 | 31.0 |
| Total Split (%) | 50.0% | 50.0% | 15.6% | 50.0% | 34.4% | 34.4% |
| Maximum Green (s) | 39.0 | 39.0 | 8.0 | 39.0 | 25.0 | 25.0 |
| Yellow Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | 0.2 | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | 0.0 | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | 0.0 | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | None | None | Min | Min | Min |
| Act Effect Green (s) | 8.7 | 8.7 | 39.0 | 39.0 | 25.0 | 25.0 |
| Actuated g/C Ratio | 0.15 | 0.15 | 0.65 | 0.65 | 0.42 | 0.42 |
| v/c Ratio | 0.39 | 0.39 | 0.78 | 0.63 | 0.87 | 0.06 |
| Control Delay | 28.0 | 8.7 | 29.4 | 8.1 | 25.5 | 5.2 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 28.0 | 8.7 | 29.4 | 8.1 | 25.5 | 5.2 |
| LOS | C | A | C | A | C | A |
| Approach Delay | 16.6 | | | 11.5 | 24.8 | |
| Approach LOS | B | | | B | C | |
| Queue Length 50th (ft) | 31 | 0 | 42 | 123 | 197 | 1 |
| Queue Length 95th (ft) | 68 | 39 | #165 | 208 | #347 | 17 |
| Internal Link Dist (ft) | 437 | | | 333 | 640 | |
| Turn Bay Length (ft) | | 211 | 245 | | | 230 |
| Base Capacity (vph) | 1072 | 1080 | 335 | 2145 | 1375 | 684 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.09 | 0.12 | 0.78 | 0.63 | 0.87 | 0.06 |

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 59.7
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.87
 Intersection Signal Delay: 17.3
 Intersection LOS: B
 Intersection Capacity Utilization 63.5%
 ICU Level of Service B
 Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2:



6:

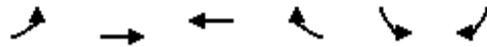


| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|------|-------|------|------|------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 0 | 38 | 0 | 1327 | 1099 | 40 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (ft) | 0 | 0 | 0 | | | 235 |
| Storage Lanes | 0 | 1 | 0 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | | 0.865 | | | | 0.850 |
| Flt Protected | | | | | | |
| Satd. Flow (prot) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Flt Permitted | | | | | | |
| Satd. Flow (perm) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Link Speed (mph) | 30 | | | 30 | 45 | |
| Link Distance (ft) | 139 | | | 720 | 506 | |
| Travel Time (s) | 3.2 | | | 16.4 | 7.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 0 | 41 | 0 | 1442 | 1195 | 43 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 41 | 0 | 1442 | 1195 | 43 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 0 | | | 0 | 0 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Sign Control | Stop | | | Free | Free | |

Intersection Summary

| | |
|-----------------------------------|--------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 40.4% |
| ICU Level of Service | A |
| Analysis Period (min) | 15 |

8:



| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|----------------------------|------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 18 | 148 | 222 | 57 | 59 | 18 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.972 | | 0.968 | |
| Flt Protected | | 0.995 | | | 0.963 | |
| Satd. Flow (prot) | 0 | 1853 | 1811 | 0 | 1736 | 0 |
| Flt Permitted | | 0.995 | | | 0.963 | |
| Satd. Flow (perm) | 0 | 1853 | 1811 | 0 | 1736 | 0 |
| Link Speed (mph) | | 35 | 30 | | 30 | |
| Link Distance (ft) | | 525 | 517 | | 157 | |
| Travel Time (s) | | 10.2 | 11.8 | | 3.6 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 20 | 161 | 241 | 62 | 64 | 20 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 181 | 303 | 0 | 84 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(ft) | | 0 | 0 | | 12 | |
| Link Offset(ft) | | 0 | 0 | | 0 | |
| Crosswalk Width(ft) | | 16 | 16 | | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | | | 9 | 15 | 9 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

| | |
|-----------------------------------|------------------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 33.9% |
| Analysis Period (min) | 15 |
| | ICU Level of Service A |

Queuing and Blocking Report Improved

5/6/2015

Intersection: 2:

| Movement | EB | EB | NB | NB | NB | SB | SB | SB |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Directions Served | L | R | L | T | T | T | T | R |
| Maximum Queue (ft) | 84 | 80 | 155 | 281 | 236 | 229 | 228 | 74 |
| Average Queue (ft) | 43 | 39 | 120 | 153 | 128 | 181 | 153 | 15 |
| 95th Queue (ft) | 93 | 82 | 167 | 288 | 255 | 242 | 224 | 64 |
| Link Distance (ft) | 408 | | | 388 | 388 | 639 | 639 | |
| Upstream Blk Time (%) | | | | | | | | |
| Queuing Penalty (veh) | | | | | | | | |
| Storage Bay Dist (ft) | | 211 | 245 | | | | | 230 |
| Storage Blk Time (%) | | | | 2 | | | 0 | |
| Queuing Penalty (veh) | | | | 4 | | | 0 | |

Intersection: 6:

| Movement | EB |
|-----------------------|----|
| Directions Served | R |
| Maximum Queue (ft) | 91 |
| Average Queue (ft) | 47 |
| 95th Queue (ft) | 87 |
| Link Distance (ft) | 81 |
| Upstream Blk Time (%) | 1 |
| Queuing Penalty (veh) | 0 |
| Storage Bay Dist (ft) | |
| Storage Blk Time (%) | |
| Queuing Penalty (veh) | |

Intersection: 8:

| Movement | SB |
|-----------------------|-----|
| Directions Served | LR |
| Maximum Queue (ft) | 52 |
| Average Queue (ft) | 34 |
| 95th Queue (ft) | 49 |
| Link Distance (ft) | 126 |
| Upstream Blk Time (%) | |
| Queuing Penalty (veh) | |
| Storage Bay Dist (ft) | |
| Storage Blk Time (%) | |
| Queuing Penalty (veh) | |

Network Summary

| |
|---------------------------------|
| Network wide Queuing Penalty: 4 |
|---------------------------------|



**SYNCHRO
ANALYSIS
2035
AM PEAK
BACKGROUND
CONDITION**

**A
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L**

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 54 | 282 | 78 | 1104 | 1399 | 38 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (ft) | 11 | 12 | 10 | 12 | 12 | 12 |
| Storage Length (ft) | 0 | 0 | 245 | | | 230 |
| Storage Lanes | 1 | 0 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | 0.887 | | | | | 0.850 |
| Flt Protected | 0.992 | | 0.950 | | | |
| Satd. Flow (prot) | 1584 | 0 | 1652 | 3282 | 3282 | 1583 |
| Flt Permitted | 0.992 | | 0.096 | | | |
| Satd. Flow (perm) | 1584 | 0 | 167 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | 120 | | | | | 41 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 1023 | | | 413 | 393 | |
| Travel Time (s) | 19.9 | | | 6.3 | 6.0 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 59 | 307 | 85 | 1200 | 1521 | 41 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 366 | 0 | 85 | 1200 | 1521 | 41 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 11 | | | 10 | 10 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.04 | 1.00 | 1.09 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 2 | | 1 | 2 | 2 | 1 |
| Detector Template | | | | | Thru | Right |
| Leading Detector (ft) | 100 | | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 6 | | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | 94 | | | 94 | 94 | |
| Detector 2 Size(ft) | 6 | | | 6 | 6 | |
| Detector 2 Type | Cl+Ex | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | 0.0 | | | 0.0 | 0.0 | |
| Turn Type | NA | | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-----|-------|-------|-------|-------|
| Permitted Phases | | | 2 | | | 6 |
| Detector Phase | 4 | | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 7.0 | | 4.0 | 20.0 | 20.0 | 20.0 |
| Minimum Split (s) | 13.0 | | 10.0 | 26.0 | 26.0 | 26.0 |
| Total Split (s) | 29.0 | | 10.0 | 51.0 | 41.0 | 41.0 |
| Total Split (%) | 36.3% | | 12.5% | 63.8% | 51.3% | 51.3% |
| Maximum Green (s) | 23.0 | | 4.0 | 45.0 | 35.0 | 35.0 |
| Yellow Time (s) | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | | None | Min | Min | Min |
| Act Effect Green (s) | 16.4 | | 43.2 | 43.2 | 35.6 | 35.6 |
| Actuated g/C Ratio | 0.23 | | 0.60 | 0.60 | 0.50 | 0.50 |
| v/c Ratio | 0.81 | | 0.46 | 0.61 | 0.93 | 0.05 |
| Control Delay | 32.0 | | 15.4 | 11.5 | 32.4 | 4.7 |
| Queue Delay | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 32.0 | | 15.4 | 11.5 | 32.4 | 4.7 |
| LOS | C | | B | B | C | A |
| Approach Delay | 32.0 | | | 11.7 | 31.7 | |
| Approach LOS | C | | | B | C | |
| Queue Length 50th (ft) | 107 | | 15 | 163 | 347 | 0 |
| Queue Length 95th (ft) | 203 | | 38 | 266 | #576 | 17 |
| Internal Link Dist (ft) | 943 | | | 333 | 313 | |
| Turn Bay Length (ft) | | | 245 | | | 230 |
| Base Capacity (vph) | 597 | | 184 | 2093 | 1628 | 805 |
| Starvation Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.61 | | 0.46 | 0.57 | 0.93 | 0.05 |

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 71.8
 Natural Cycle: 80
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.93
 Intersection Signal Delay: 23.8
 Intersection LOS: C
 Intersection Capacity Utilization 78.4%
 ICU Level of Service D
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2:





**SYNCHRO
ANALYSIS
2035
PM PEAK
BACKGROUND
CONDITION**

**A
P
P
E
N
D
I
X

M**

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 45 | 176 | 256 | 1781 | 1520 | 54 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (ft) | 11 | 12 | 10 | 12 | 12 | 12 |
| Storage Length (ft) | 0 | 0 | 245 | | | 230 |
| Storage Lanes | 1 | 0 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | 0.893 | | | | | 0.850 |
| Flt Protected | 0.990 | | 0.950 | | | |
| Satd. Flow (prot) | 1592 | 0 | 1652 | 3282 | 3282 | 1583 |
| Flt Permitted | 0.990 | | 0.078 | | | |
| Satd. Flow (perm) | 1592 | 0 | 136 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | 171 | | | | | 58 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 1023 | | | 413 | 393 | |
| Travel Time (s) | 19.9 | | | 6.3 | 6.0 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 49 | 191 | 278 | 1936 | 1652 | 59 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 240 | 0 | 278 | 1936 | 1652 | 59 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 11 | | | 10 | 10 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.04 | 1.00 | 1.09 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 2 | | 1 | 2 | 2 | 1 |
| Detector Template | | | | | Thru | Right |
| Leading Detector (ft) | 100 | | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 6 | | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | 94 | | | 94 | 94 | |
| Detector 2 Size(ft) | 6 | | | 6 | 6 | |
| Detector 2 Type | Cl+Ex | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | 0.0 | | | 0.0 | 0.0 | |
| Turn Type | NA | | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-----|-------|-------|-------|-------|
| Permitted Phases | | | 2 | | | 6 |
| Detector Phase | 4 | | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 7.0 | | 4.0 | 20.0 | 20.0 | 20.0 |
| Minimum Split (s) | 13.0 | | 10.0 | 26.0 | 26.0 | 26.0 |
| Total Split (s) | 14.0 | | 23.0 | 76.0 | 53.0 | 53.0 |
| Total Split (%) | 15.6% | | 25.6% | 84.4% | 58.9% | 58.9% |
| Maximum Green (s) | 8.0 | | 17.0 | 70.0 | 47.0 | 47.0 |
| Yellow Time (s) | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | | None | Min | Min | Min |
| Act Effct Green (s) | 7.8 | | 66.6 | 66.6 | 45.4 | 45.4 |
| Actuated g/C Ratio | 0.09 | | 0.77 | 0.77 | 0.53 | 0.53 |
| v/c Ratio | 0.81 | | 0.75 | 0.77 | 0.96 | 0.07 |
| Control Delay | 34.9 | | 33.0 | 8.1 | 34.9 | 3.4 |
| Queue Delay | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 34.9 | | 33.0 | 8.1 | 34.9 | 3.4 |
| LOS | C | | C | A | C | A |
| Approach Delay | 34.9 | | | 11.2 | 33.8 | |
| Approach LOS | C | | | B | C | |
| Queue Length 50th (ft) | 38 | | 95 | 242 | 450 | 0 |
| Queue Length 95th (ft) | #158 | | #201 | 322 | #635 | 18 |
| Internal Link Dist (ft) | 943 | | | 333 | 313 | |
| Turn Bay Length (ft) | | | 245 | | | 230 |
| Base Capacity (vph) | 303 | | 404 | 2673 | 1794 | 892 |
| Starvation Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.79 | | 0.69 | 0.72 | 0.92 | 0.07 |

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 86.4
 Natural Cycle: 90
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.96
 Intersection Signal Delay: 21.8 Intersection LOS: C
 Intersection Capacity Utilization 84.5% ICU Level of Service E
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2:





**SYNCHRO
ANALYSIS
2035
AM PEAK
BUILD CONDITION**

**A
P
P
E
N
D
I
X

N**

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 84 | 278 | 109 | 1085 | 1412 | 38 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (ft) | 11 | 12 | 10 | 12 | 12 | 12 |
| Storage Length (ft) | 0 | 0 | 245 | | | 230 |
| Storage Lanes | 1 | 0 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | 0.896 | | | | | 0.850 |
| Flt Protected | 0.989 | | 0.950 | | | |
| Satd. Flow (prot) | 1567 | 0 | 1532 | 3282 | 3282 | 1583 |
| Flt Permitted | 0.989 | | 0.095 | | | |
| Satd. Flow (perm) | 1567 | 0 | 153 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | 118 | | | | | 41 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 517 | | | 413 | 720 | |
| Travel Time (s) | 10.1 | | | 6.3 | 10.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 10% | 2% | 10% | 10% | 10% | 2% |
| Adj. Flow (vph) | 91 | 302 | 118 | 1179 | 1535 | 41 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 393 | 0 | 118 | 1179 | 1535 | 41 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 11 | | | 10 | 10 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.04 | 1.00 | 1.09 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 1 | | 1 | 2 | 2 | 1 |
| Detector Template | | | | | Thru | Right |
| Leading Detector (ft) | 20 | | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 20 | | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | | | | 94 | 94 | |
| Detector 2 Size(ft) | | | | 6 | 6 | |
| Detector 2 Type | | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | | | 0.0 | 0.0 | |
| Turn Type | NA | | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-----|-------|-------|-------|-------|
| Permitted Phases | | | 2 | | | 6 |
| Detector Phase | 4 | | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 7.0 | | 4.0 | 20.0 | 20.0 | 20.0 |
| Minimum Split (s) | 13.0 | | 10.0 | 26.0 | 26.0 | 26.0 |
| Total Split (s) | 28.0 | | 10.0 | 52.0 | 42.0 | 42.0 |
| Total Split (%) | 35.0% | | 12.5% | 65.0% | 52.5% | 52.5% |
| Maximum Green (s) | 22.0 | | 4.0 | 46.0 | 36.0 | 36.0 |
| Yellow Time (s) | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | | None | Min | Min | Min |
| Act Effect Green (s) | 18.1 | | 46.2 | 46.2 | 36.1 | 36.1 |
| Actuated g/C Ratio | 0.24 | | 0.61 | 0.61 | 0.47 | 0.47 |
| v/c Ratio | 0.85 | | 0.72 | 0.59 | 0.99 | 0.05 |
| Control Delay | 37.6 | | 36.1 | 11.5 | 42.8 | 4.6 |
| Queue Delay | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 37.6 | | 36.1 | 11.5 | 42.8 | 4.6 |
| LOS | D | | D | B | D | A |
| Approach Delay | 37.6 | | | 13.8 | 41.8 | |
| Approach LOS | D | | | B | D | |
| Queue Length 50th (ft) | 126 | | 23 | 177 | -397 | 0 |
| Queue Length 95th (ft) | #263 | | #79 | 251 | #573 | 16 |
| Internal Link Dist (ft) | 437 | | | 333 | 640 | |
| Turn Bay Length (ft) | | | 245 | | | 230 |
| Base Capacity (vph) | 537 | | 165 | 1985 | 1553 | 770 |
| Starvation Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.73 | | 0.72 | 0.59 | 0.99 | 0.05 |

Intersection Summary

| | |
|------------------------------------|------------------------|
| Area Type: | Other |
| Cycle Length: | 80 |
| Actuated Cycle Length: | 76.3 |
| Natural Cycle: | 80 |
| Control Type: | Actuated-Uncoordinated |
| Maximum v/c Ratio: | 0.99 |
| Intersection Signal Delay: | 30.1 |
| Intersection LOS: | C |
| Intersection Capacity Utilization: | 81.9% |
| ICU Level of Service: | D |
| Analysis Period (min): | 15 |

~ Volume exceeds capacity, queue is theoretically infinite.

2:

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2:



6:

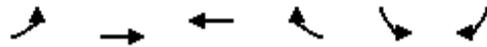


| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|------|-------|------|------|------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 0 | 39 | 0 | 1170 | 1411 | 42 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (ft) | 0 | 0 | 0 | | | 235 |
| Storage Lanes | 0 | 1 | 0 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | | 0.865 | | | | 0.850 |
| Flt Protected | | | | | | |
| Satd. Flow (prot) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Flt Permitted | | | | | | |
| Satd. Flow (perm) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Link Speed (mph) | 30 | | | 30 | 45 | |
| Link Distance (ft) | 139 | | | 720 | 506 | |
| Travel Time (s) | 3.2 | | | 16.4 | 7.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 0 | 42 | 0 | 1272 | 1534 | 46 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 42 | 0 | 1272 | 1534 | 46 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 0 | | | 0 | 0 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Sign Control | Stop | | | Free | Free | |

Intersection Summary

| | |
|-----------------------------------|--------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 49.0% |
| ICU Level of Service | A |
| Analysis Period (min) | 15 |

8:



| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|----------------------------|------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 13 | 328 | 116 | 31 | 34 | 13 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.971 | | 0.963 | |
| Flt Protected | | 0.998 | | | 0.965 | |
| Satd. Flow (prot) | 0 | 1859 | 1809 | 0 | 1731 | 0 |
| Flt Permitted | | 0.998 | | | 0.965 | |
| Satd. Flow (perm) | 0 | 1859 | 1809 | 0 | 1731 | 0 |
| Link Speed (mph) | | 35 | 30 | | 30 | |
| Link Distance (ft) | | 525 | 517 | | 157 | |
| Travel Time (s) | | 10.2 | 11.8 | | 3.6 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 14 | 357 | 126 | 34 | 37 | 14 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 371 | 160 | 0 | 51 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(ft) | | 0 | 0 | | 12 | |
| Link Offset(ft) | | 0 | 0 | | 0 | |
| Crosswalk Width(ft) | | 16 | 16 | | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | | | 9 | 15 | 9 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

| | |
|-----------------------------------|------------------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 37.8% |
| Analysis Period (min) | 15 |
| | ICU Level of Service A |

Queuing and Blocking Report

5/6/2015

Intersection: 2:

| Movement | EB | NB | NB | NB | SB | SB | SB |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|
| Directions Served | LR | L | T | T | T | T | R |
| Maximum Queue (ft) | 150 | 94 | 196 | 189 | 350 | 220 | 28 |
| Average Queue (ft) | 99 | 64 | 136 | 102 | 265 | 196 | 6 |
| 95th Queue (ft) | 159 | 105 | 195 | 187 | 356 | 231 | 24 |
| Link Distance (ft) | 408 | | 397 | 397 | 640 | 640 | |
| Upstream Blk Time (%) | | | | | | | |
| Queuing Penalty (veh) | | | | | | | |
| Storage Bay Dist (ft) | | 245 | | | | | 230 |
| Storage Blk Time (%) | | | | | | 0 | |
| Queuing Penalty (veh) | | | | | | 0 | |

Intersection: 6:

| Movement | EB |
|-----------------------|----|
| Directions Served | R |
| Maximum Queue (ft) | 43 |
| Average Queue (ft) | 24 |
| 95th Queue (ft) | 51 |
| Link Distance (ft) | 81 |
| Upstream Blk Time (%) | |
| Queuing Penalty (veh) | |
| Storage Bay Dist (ft) | |
| Storage Blk Time (%) | |
| Queuing Penalty (veh) | |

Intersection: 8:

| Movement | EB | SB |
|-----------------------|-----|-----|
| Directions Served | LT | LR |
| Maximum Queue (ft) | 29 | 29 |
| Average Queue (ft) | 6 | 23 |
| 95th Queue (ft) | 25 | 42 |
| Link Distance (ft) | 501 | 126 |
| Upstream Blk Time (%) | | |
| Queuing Penalty (veh) | | |
| Storage Bay Dist (ft) | | |
| Storage Blk Time (%) | | |
| Queuing Penalty (veh) | | |

Network Summary

Network wide Queuing Penalty: 0



**SYNCHRO
ANALYSIS
2035
PM PEAK
BUILD CONDITION**

**A
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2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 100 | 170 | 313 | 1749 | 1535 | 54 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Width (ft) | 11 | 12 | 10 | 12 | 12 | 12 |
| Storage Length (ft) | 0 | 0 | 245 | | | 230 |
| Storage Lanes | 1 | 0 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | 0.915 | | | | | 0.850 |
| Flt Protected | 0.982 | | 0.950 | | | |
| Satd. Flow (prot) | 1572 | 0 | 1532 | 3282 | 3282 | 1583 |
| Flt Permitted | 0.982 | | 0.082 | | | |
| Satd. Flow (perm) | 1572 | 0 | 132 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | 80 | | | | | 53 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 517 | | | 413 | 720 | |
| Travel Time (s) | 10.1 | | | 6.3 | 10.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 10% | 2% | 10% | 10% | 10% | 2% |
| Adj. Flow (vph) | 109 | 185 | 340 | 1901 | 1668 | 59 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 294 | 0 | 340 | 1901 | 1668 | 59 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 11 | | | 10 | 10 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.04 | 1.00 | 1.09 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 1 | | 1 | 2 | 2 | 1 |
| Detector Template | | | | | Thru | Right |
| Leading Detector (ft) | 20 | | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 20 | | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | | | | 94 | 94 | |
| Detector 2 Size(ft) | | | | 6 | 6 | |
| Detector 2 Type | | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | | | 0.0 | 0.0 | |
| Turn Type | NA | | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-----|-------|-------|-------|-------|
| Permitted Phases | | | 2 | | | 6 |
| Detector Phase | 4 | | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 7.0 | | 4.0 | 20.0 | 20.0 | 20.0 |
| Minimum Split (s) | 13.0 | | 10.0 | 26.0 | 26.0 | 26.0 |
| Total Split (s) | 20.0 | | 21.0 | 70.0 | 49.0 | 49.0 |
| Total Split (%) | 22.2% | | 23.3% | 77.8% | 54.4% | 54.4% |
| Maximum Green (s) | 14.0 | | 15.0 | 64.0 | 43.0 | 43.0 |
| Yellow Time (s) | 4.0 | | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | | None | Min | Min | Min |
| Act Effect Green (s) | 14.0 | | 64.0 | 64.0 | 43.0 | 43.0 |
| Actuated g/C Ratio | 0.16 | | 0.71 | 0.71 | 0.48 | 0.48 |
| v/c Ratio | 0.94 | | 1.04 | 0.81 | 1.06 | 0.08 |
| Control Delay | 67.7 | | 87.5 | 12.7 | 66.6 | 4.7 |
| Queue Delay | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 67.7 | | 87.5 | 12.7 | 66.6 | 4.7 |
| LOS | E | | F | B | E | A |
| Approach Delay | 67.7 | | | 24.0 | 64.4 | |
| Approach LOS | E | | | C | E | |
| Queue Length 50th (ft) | 124 | | -166 | 330 | -555 | 2 |
| Queue Length 95th (ft) | #282 | | #336 | 438 | #692 | 22 |
| Internal Link Dist (ft) | 437 | | | 333 | 640 | |
| Turn Bay Length (ft) | | | 245 | | | 230 |
| Base Capacity (vph) | 312 | | 327 | 2333 | 1568 | 784 |
| Starvation Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.94 | | 1.04 | 0.81 | 1.06 | 0.08 |

Intersection Summary

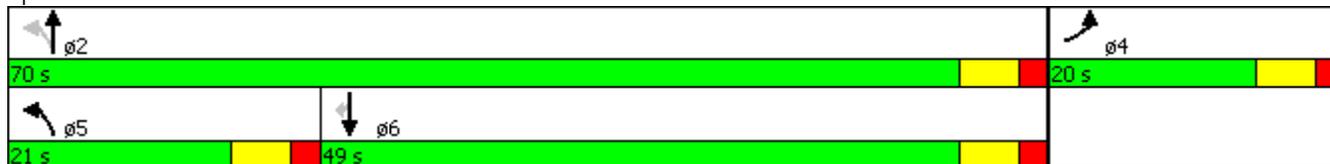
| | |
|---|------------------------|
| Area Type: | Other |
| Cycle Length: | 90 |
| Actuated Cycle Length: | 90 |
| Natural Cycle: | 100 |
| Control Type: | Actuated-Uncoordinated |
| Maximum v/c Ratio: | 1.06 |
| Intersection Signal Delay: | 43.4 |
| Intersection LOS: | D |
| Intersection Capacity Utilization: | 90.8% |
| ICU Level of Service: | E |
| Analysis Period (min): | 15 |
| ~ Volume exceeds capacity, queue is theoretically infinite. | |

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2:



6:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|------|-------|------|------|------|-------|
| Lane Configurations | | ↗ | | ↑↑ | ↓↓ | ↙ |
| Volume (vph) | 0 | 38 | 0 | 1851 | 1551 | 40 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (ft) | 0 | 0 | 0 | | | 235 |
| Storage Lanes | 0 | 1 | 0 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | | 0.865 | | | | 0.850 |
| Flt Protected | | | | | | |
| Satd. Flow (prot) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Flt Permitted | | | | | | |
| Satd. Flow (perm) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Link Speed (mph) | 30 | | | 30 | 45 | |
| Link Distance (ft) | 139 | | | 720 | 506 | |
| Travel Time (s) | 3.2 | | | 16.4 | 7.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 0 | 41 | 0 | 2012 | 1686 | 43 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 41 | 0 | 2012 | 1686 | 43 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 0 | | | 0 | 0 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Sign Control | Stop | | | Free | Free | |

Intersection Summary

| | |
|-----------------------------------|--------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 54.5% |
| ICU Level of Service | A |
| Analysis Period (min) | 15 |

8:



| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|----------------------------|------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 18 | 211 | 310 | 57 | 59 | 18 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.979 | | 0.968 | |
| Flt Protected | | 0.996 | | | 0.963 | |
| Satd. Flow (prot) | 0 | 1855 | 1824 | 0 | 1736 | 0 |
| Flt Permitted | | 0.996 | | | 0.963 | |
| Satd. Flow (perm) | 0 | 1855 | 1824 | 0 | 1736 | 0 |
| Link Speed (mph) | | 35 | 30 | | 30 | |
| Link Distance (ft) | | 525 | 517 | | 157 | |
| Travel Time (s) | | 10.2 | 11.8 | | 3.6 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 20 | 229 | 337 | 62 | 64 | 20 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 249 | 399 | 0 | 84 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(ft) | | 0 | 0 | | 12 | |
| Link Offset(ft) | | 0 | 0 | | 0 | |
| Crosswalk Width(ft) | | 16 | 16 | | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | | | 9 | 15 | 9 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

| | |
|-----------------------------------|------------------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 37.0% |
| Analysis Period (min) | 15 |
| | ICU Level of Service A |

Queuing and Blocking Report

5/6/2015

Intersection: 2:

| Movement | EB | NB | NB | NB | SB | SB | SB |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|
| Directions Served | LR | L | T | T | T | T | R |
| Maximum Queue (ft) | 208 | 269 | 333 | 232 | 469 | 404 | 95 |
| Average Queue (ft) | 177 | 150 | 176 | 151 | 367 | 318 | 42 |
| 95th Queue (ft) | 224 | 258 | 334 | 261 | 497 | 464 | 94 |
| Link Distance (ft) | 408 | | 397 | 397 | 640 | 640 | |
| Upstream Blk Time (%) | | | | | | | |
| Queuing Penalty (veh) | | | | | | | |
| Storage Bay Dist (ft) | | 245 | | | | | 230 |
| Storage Blk Time (%) | | 0 | 2 | | | 19 | |
| Queuing Penalty (veh) | | 1 | 5 | | | 10 | |

Intersection: 6:

| Movement | EB |
|-----------------------|----|
| Directions Served | R |
| Maximum Queue (ft) | 45 |
| Average Queue (ft) | 13 |
| 95th Queue (ft) | 42 |
| Link Distance (ft) | 81 |
| Upstream Blk Time (%) | |
| Queuing Penalty (veh) | |
| Storage Bay Dist (ft) | |
| Storage Blk Time (%) | |
| Queuing Penalty (veh) | |

Intersection: 8:

| Movement | EB | SB |
|-----------------------|-----|-----|
| Directions Served | LT | LR |
| Maximum Queue (ft) | 52 | 52 |
| Average Queue (ft) | 10 | 34 |
| 95th Queue (ft) | 44 | 49 |
| Link Distance (ft) | 501 | 126 |
| Upstream Blk Time (%) | | |
| Queuing Penalty (veh) | | |
| Storage Bay Dist (ft) | | |
| Storage Blk Time (%) | | |
| Queuing Penalty (veh) | | |

Network Summary

Network wide Queuing Penalty: 16



SYNCHRO ANALYSIS
2035 PM PEAK
BUILD CONDITION
- WITH
IMPROVEMENTS

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P

Lanes, Volumes, Timings

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|-------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 100 | 170 | 313 | 1749 | 1535 | 54 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (ft) | 0 | 261 | 245 | | | 230 |
| Storage Lanes | 1 | 1 | 1 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Fr _t | | 0.850 | | | | 0.850 |
| Fl _t Protected | 0.950 | | 0.950 | | | |
| Satd. Flow (prot) | 1641 | 1583 | 1641 | 3282 | 3282 | 1583 |
| Fl _t Permitted | 0.950 | | 0.078 | | | |
| Satd. Flow (perm) | 1641 | 1583 | 135 | 3282 | 3282 | 1583 |
| Right Turn on Red | | Yes | | | | Yes |
| Satd. Flow (RTOR) | | 185 | | | | 55 |
| Link Speed (mph) | 35 | | | 45 | 45 | |
| Link Distance (ft) | 517 | | | 413 | 720 | |
| Travel Time (s) | 10.1 | | | 6.3 | 10.9 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 10% | 2% | 10% | 10% | 10% | 2% |
| Adj. Flow (vph) | 109 | 185 | 340 | 1901 | 1668 | 59 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 109 | 185 | 340 | 1901 | 1668 | 59 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 12 | | | 12 | 12 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Number of Detectors | 1 | 1 | 1 | 2 | 2 | 1 |
| Detector Template | | Right | | | Thru | Right |
| Leading Detector (ft) | 20 | 20 | 20 | 100 | 100 | 20 |
| Trailing Detector (ft) | 0 | 0 | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | 0 | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 20 | 20 | 20 | 6 | 6 | 20 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | | | | 94 | 94 | |
| Detector 2 Size(ft) | | | | 6 | 6 | |
| Detector 2 Type | | | | Cl+Ex | Cl+Ex | |
| Detector 2 Channel | | | | | | |
| Detector 2 Extend (s) | | | | 0.0 | 0.0 | |
| Turn Type | NA | Perm | pm+pt | NA | NA | Perm |
| Protected Phases | 4 | | 5 | 2 | 6 | |
| Permitted Phases | | 4 | 2 | | | 6 |

2:



| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|-------------------------|-------|-------|-------|-------|-------|-------|
| Detector Phase | 4 | 4 | 5 | 2 | 6 | 6 |
| Switch Phase | | | | | | |
| Minimum Initial (s) | 7.0 | 7.0 | 7.0 | 20.0 | 17.0 | 17.0 |
| Minimum Split (s) | 13.0 | 13.0 | 13.0 | 26.0 | 23.0 | 23.0 |
| Total Split (s) | 16.5 | 16.5 | 22.0 | 73.5 | 51.5 | 51.5 |
| Total Split (%) | 18.3% | 18.3% | 24.4% | 81.7% | 57.2% | 57.2% |
| Maximum Green (s) | 10.5 | 10.5 | 16.0 | 67.5 | 45.5 | 45.5 |
| Yellow Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Lead/Lag | | | Lead | | Lag | Lag |
| Lead-Lag Optimize? | | | Yes | | Yes | Yes |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Minimum Gap (s) | 0.2 | 0.2 | 0.2 | 2.0 | 2.0 | 2.0 |
| Time Before Reduce (s) | 0.0 | 0.0 | 0.0 | 25.0 | 25.0 | 25.0 |
| Time To Reduce (s) | 0.0 | 0.0 | 0.0 | 20.0 | 20.0 | 20.0 |
| Recall Mode | None | None | None | Min | Min | Min |
| Act Effct Green (s) | 9.6 | 9.6 | 67.5 | 67.5 | 45.5 | 45.5 |
| Actuated g/C Ratio | 0.11 | 0.11 | 0.76 | 0.76 | 0.51 | 0.51 |
| v/c Ratio | 0.62 | 0.55 | 0.91 | 0.76 | 1.00 | 0.07 |
| Control Delay | 54.0 | 12.7 | 54.7 | 9.0 | 43.9 | 4.0 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 54.0 | 12.7 | 54.7 | 9.0 | 43.9 | 4.0 |
| LOS | D | B | D | A | D | A |
| Approach Delay | 28.0 | | | 16.0 | 42.5 | |
| Approach LOS | C | | | B | D | |
| Queue Length 50th (ft) | 60 | 0 | 142 | 272 | -483 | 1 |
| Queue Length 95th (ft) | #120 | 60 | #307 | 362 | #663 | 20 |
| Internal Link Dist (ft) | 437 | | | 333 | 640 | |
| Turn Bay Length (ft) | | 261 | 245 | | | 230 |
| Base Capacity (vph) | 193 | 350 | 372 | 2487 | 1676 | 835 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.56 | 0.53 | 0.91 | 0.76 | 1.00 | 0.07 |

Intersection Summary

| | |
|---|------------------------|
| Area Type: | Other |
| Cycle Length: | 90 |
| Actuated Cycle Length: | 89.1 |
| Natural Cycle: | 90 |
| Control Type: | Actuated-Uncoordinated |
| Maximum v/c Ratio: | 1.00 |
| Intersection Signal Delay: | 27.6 |
| Intersection LOS: | C |
| Intersection Capacity Utilization: | 80.6% |
| ICU Level of Service: | D |
| Analysis Period (min): | 15 |
| ~ Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles. | |

2:

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2:



6:

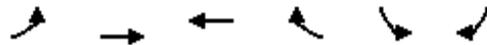


| Lane Group | EBL | EBR | NBL | NBT | SBT | SBR |
|----------------------------|------|-------|------|------|------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 0 | 38 | 0 | 1851 | 1551 | 40 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (ft) | 0 | 0 | 0 | | | 235 |
| Storage Lanes | 0 | 1 | 0 | | | 1 |
| Taper Length (ft) | 25 | | 25 | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 |
| Frt | | 0.865 | | | | 0.850 |
| Flt Protected | | | | | | |
| Satd. Flow (prot) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Flt Permitted | | | | | | |
| Satd. Flow (perm) | 0 | 1611 | 0 | 3282 | 3282 | 1583 |
| Link Speed (mph) | 30 | | | 30 | 45 | |
| Link Distance (ft) | 139 | | | 720 | 506 | |
| Travel Time (s) | 3.2 | | | 16.4 | 7.7 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 2% | 2% | 2% | 10% | 10% | 2% |
| Adj. Flow (vph) | 0 | 41 | 0 | 2012 | 1686 | 43 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 41 | 0 | 2012 | 1686 | 43 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(ft) | 0 | | | 0 | 0 | |
| Link Offset(ft) | 0 | | | 0 | 0 | |
| Crosswalk Width(ft) | 16 | | | 16 | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | | | 9 |
| Sign Control | Stop | | | Free | Free | |

Intersection Summary

| | |
|-----------------------------------|--------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 54.5% |
| ICU Level of Service | A |
| Analysis Period (min) | 15 |

8:



| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|----------------------------|------|-------|-------|-------|-------|-------|
| Lane Configurations | | | | | | |
| Volume (vph) | 18 | 211 | 310 | 57 | 59 | 18 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.979 | | 0.968 | |
| Flt Protected | | 0.996 | | | 0.963 | |
| Satd. Flow (prot) | 0 | 1855 | 1824 | 0 | 1736 | 0 |
| Flt Permitted | | 0.996 | | | 0.963 | |
| Satd. Flow (perm) | 0 | 1855 | 1824 | 0 | 1736 | 0 |
| Link Speed (mph) | | 35 | 30 | | 30 | |
| Link Distance (ft) | | 525 | 517 | | 157 | |
| Travel Time (s) | | 10.2 | 11.8 | | 3.6 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 20 | 229 | 337 | 62 | 64 | 20 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 249 | 399 | 0 | 84 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(ft) | | 0 | 0 | | 12 | |
| Link Offset(ft) | | 0 | 0 | | 0 | |
| Crosswalk Width(ft) | | 16 | 16 | | 16 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | | | 9 | 15 | 9 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

| | |
|-----------------------------------|------------------------|
| Area Type: | Other |
| Control Type: | Unsignalized |
| Intersection Capacity Utilization | 37.0% |
| Analysis Period (min) | 15 |
| | ICU Level of Service A |

Queuing and Blocking Report

Improved

5/6/2015

Intersection: 2:

| Movement | EB | EB | NB | NB | NB | SB | SB | SB |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Directions Served | L | R | L | T | T | T | T | R |
| Maximum Queue (ft) | 83 | 122 | 258 | 210 | 139 | 263 | 283 | 31 |
| Average Queue (ft) | 49 | 68 | 185 | 118 | 102 | 225 | 210 | 18 |
| 95th Queue (ft) | 87 | 132 | 295 | 198 | 158 | 262 | 274 | 43 |
| Link Distance (ft) | 408 | | | 388 | 388 | 639 | 639 | |
| Upstream Blk Time (%) | | | | | | | | |
| Queuing Penalty (veh) | | | | | | | | |
| Storage Bay Dist (ft) | | 261 | 245 | | | | | 230 |
| Storage Blk Time (%) | | | 4 | | | | 4 | |
| Queuing Penalty (veh) | | | 33 | | | | 2 | |

Intersection: 6:

| Movement | EB |
|-----------------------|----|
| Directions Served | R |
| Maximum Queue (ft) | 41 |
| Average Queue (ft) | 12 |
| 95th Queue (ft) | 39 |
| Link Distance (ft) | 81 |
| Upstream Blk Time (%) | |
| Queuing Penalty (veh) | |
| Storage Bay Dist (ft) | |
| Storage Blk Time (%) | |
| Queuing Penalty (veh) | |

Intersection: 8:

| Movement | SB |
|-----------------------|-----|
| Directions Served | LR |
| Maximum Queue (ft) | 53 |
| Average Queue (ft) | 37 |
| 95th Queue (ft) | 57 |
| Link Distance (ft) | 126 |
| Upstream Blk Time (%) | |
| Queuing Penalty (veh) | |
| Storage Bay Dist (ft) | |
| Storage Blk Time (%) | |
| Queuing Penalty (veh) | |

Network Summary

Network wide Queuing Penalty: 35



**TURN LANE WARRANT
GRAPHS**

**A
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E
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X

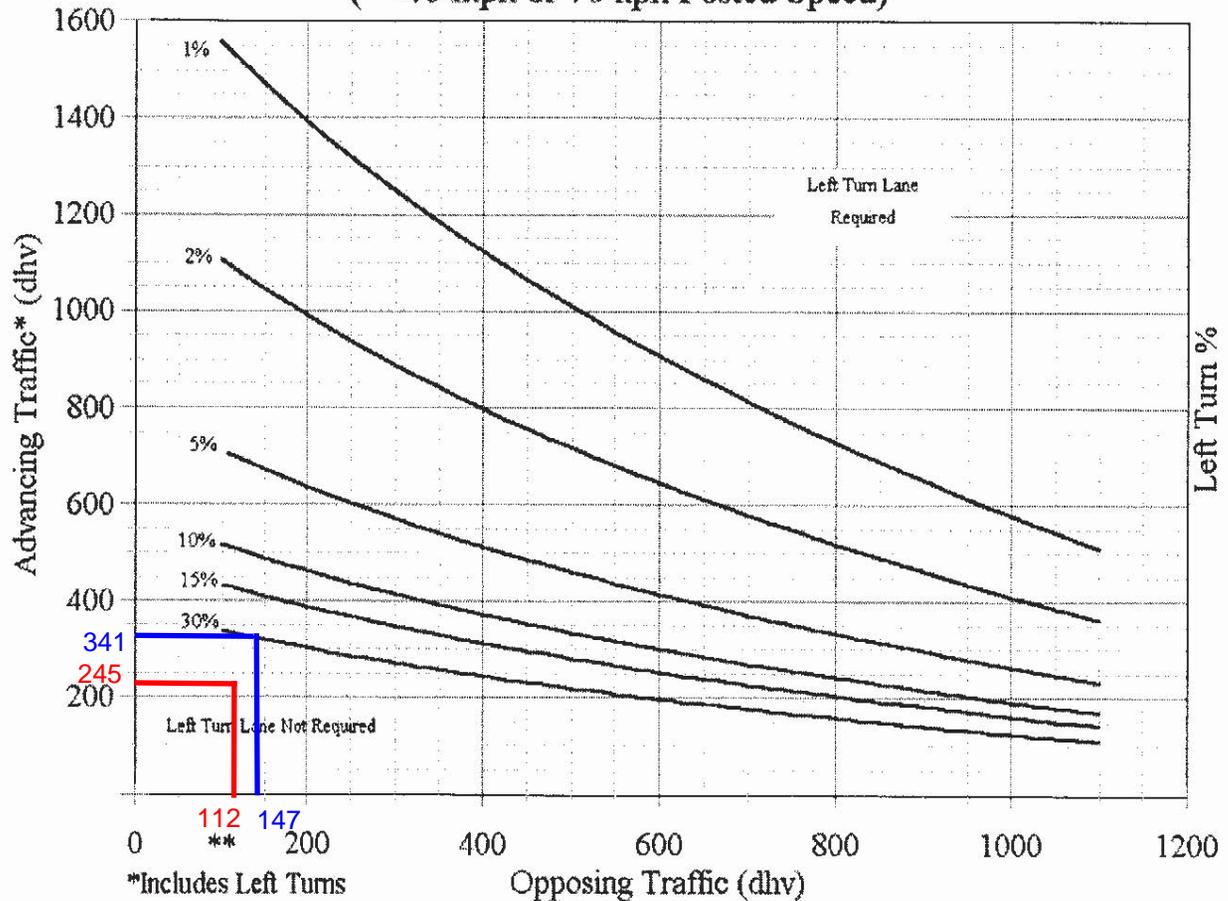
Q**

Hills-Miller Road at Full Access

2015 AM Build Condition

2035 AM Build Condition

2-Lane Highway Left Turn Lane Warrant (=<40 mph or 70 kph Posted Speed)



October 2004

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

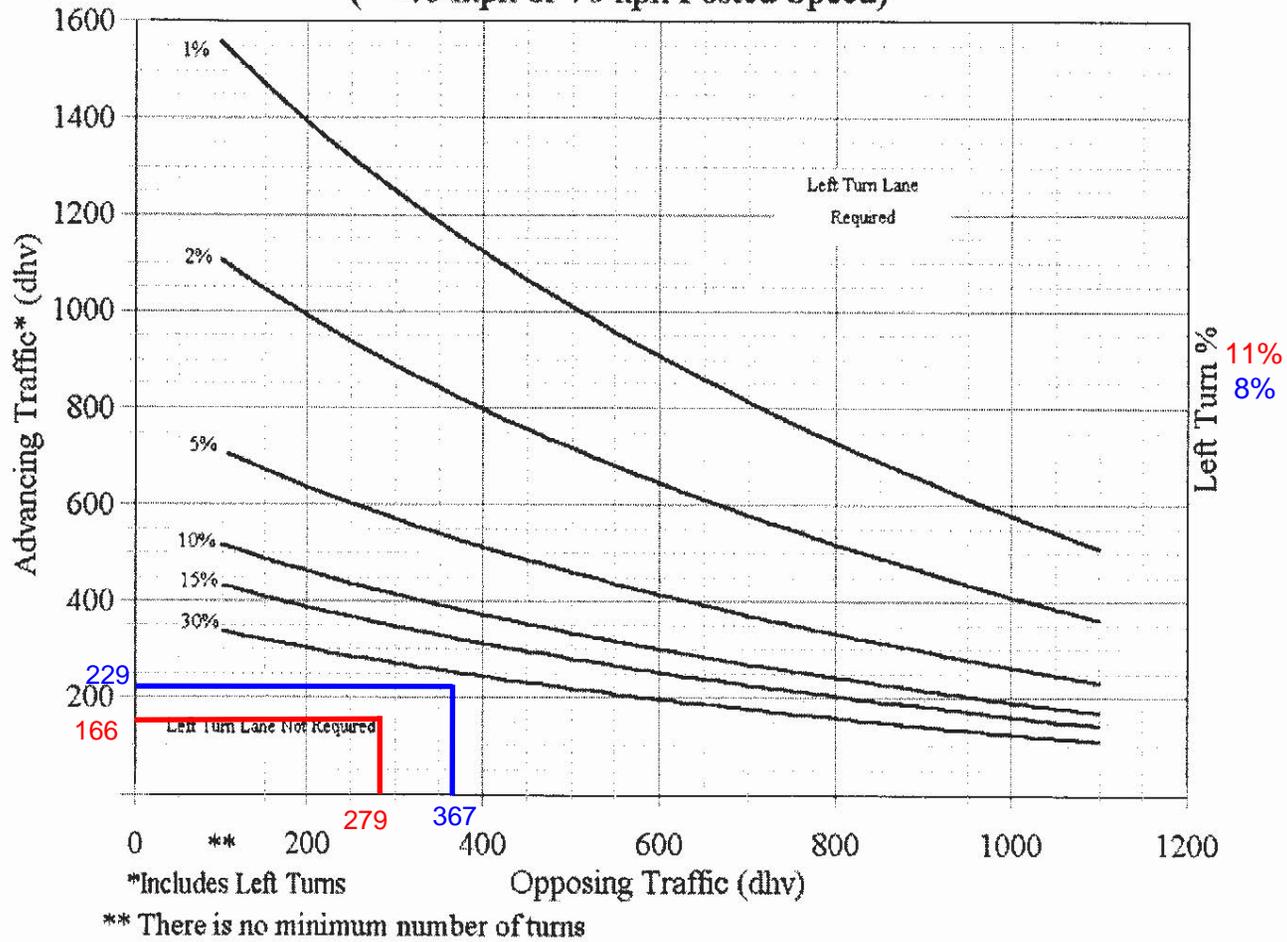
| | |
|--|----------------|
| 2-LANE LEFT TURN LANE WARRANT (LOW SPEED) | 401-5aE |
| REFERENCE SECTION 401.6.1 | |

Hills-Miller Road at Full Access

2015 PM Build Condition

2035 PM Build Condition

2-Lane Highway Left Turn Lane Warrant (= \leq 40 mph or 70 kph Posted Speed)



October 2004

2-LANE LEFT TURN LANE
WARRANT (LOW SPEED)

REFERENCE SECTION
401.6.1

401-5aE

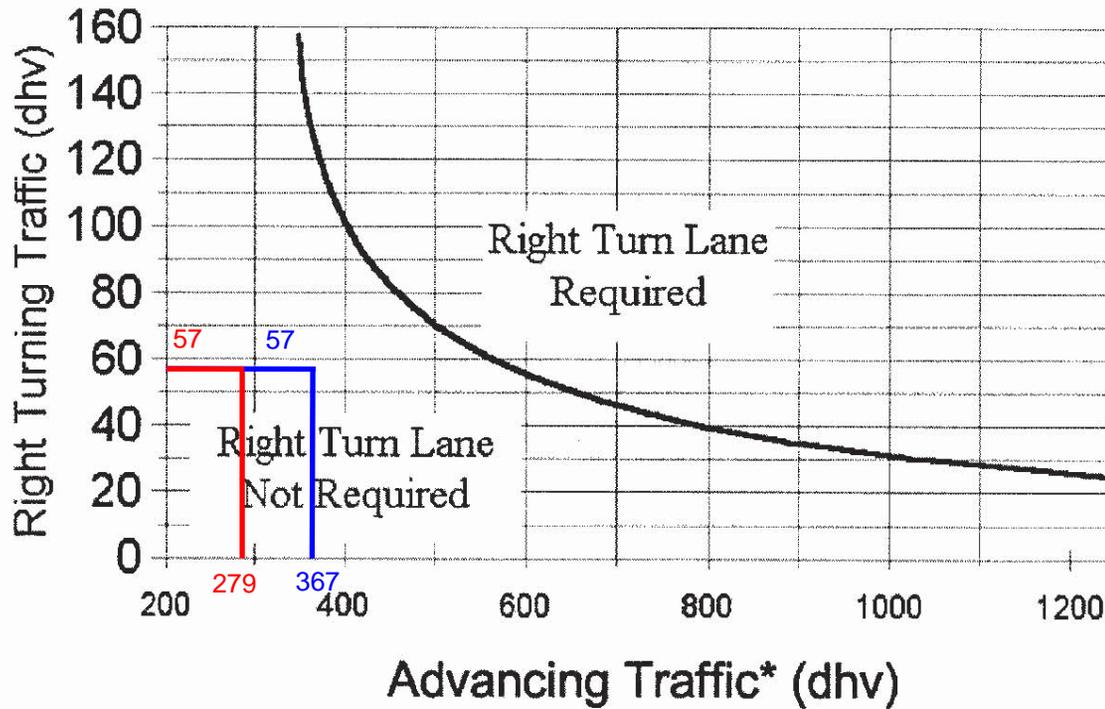
Hills-Miller Road at Full Access

2015 PM Build Condition

2035 PM Build Condition

2-Lane Highway Right Turn Lane Warrant

= < 40 mph or 70 kph Posted Speed



*Includes Right Turns

October 2004

2-LANE RIGHT TURN LANE
WARRANT (LOW SPEED)

REFERENCE SECTION
401.6.3

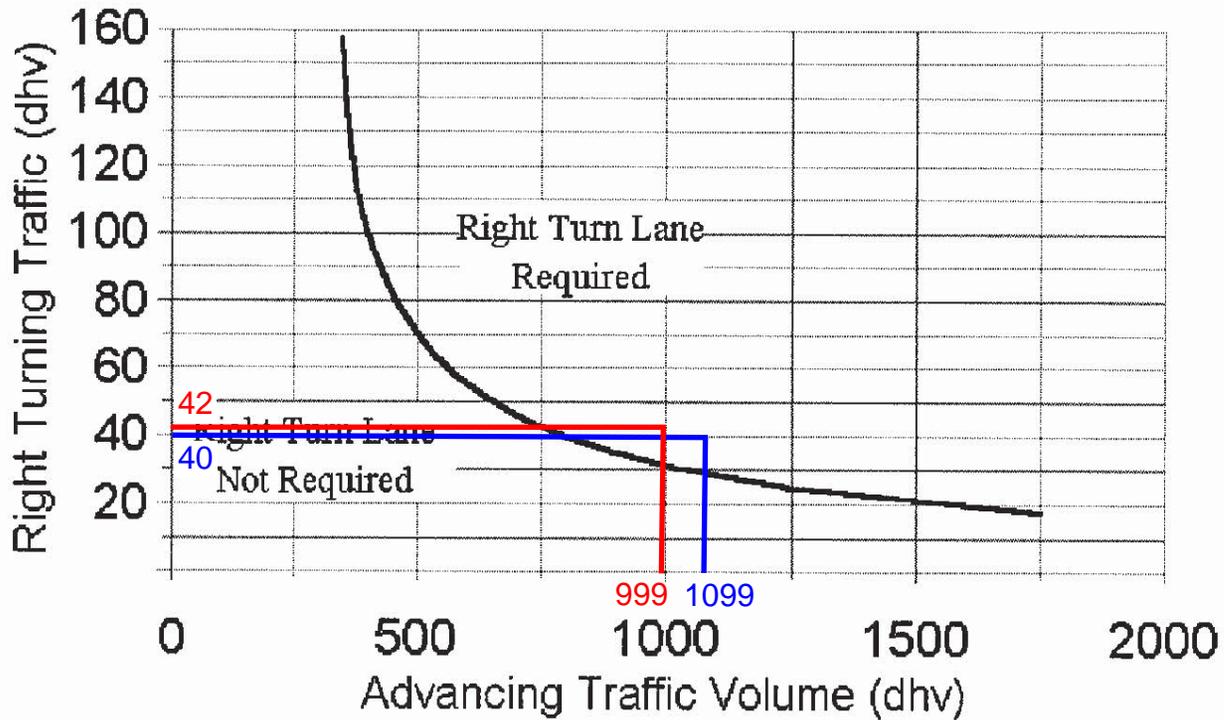
401-6aE

US 23 Southbound @ RI/RO Access

2015 AM Build Condition

2015 PM Build Condition

4 Lane Highway Right Turn Lane Warrant
(>40 mph or 70 kph Posted Speed)



October 2004

4-LANE RIGHT TURN LANE
WARRANT (HIGH SPEED)

REFERENCE SECTION
401.6.3

401-6DE



**Turn Lane Length
Calculations and
Worksheets**

**A
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R**



**Southbound U.S. 23 Right Turn Lane Length Calculations:
ODOT Figures 401-9E & 401-10E L&D Manual Volume One**

2015 Build A.M. Peak

Design Hour Volume: 42 vehicles/hour

Design Speed: 55 mph

Condition B: 285' Average vehicle/hour = $\frac{42 \text{ vehicles}}{(3600 \frac{\text{sec}}{\text{hour}}) / (80 \frac{\text{sec}}{\text{cycle}})} = 0.93 \text{ veh/cycle}$

Condition C: 164' + 50' = 214'

2035 Build A.M. Peak

Design Hour Volume: 42 vehicles/hour

Design Speed: 55 mph

Condition B: 285' Average vehicle/hour = $\frac{42 \text{ vehicles}}{(3600 \frac{\text{sec}}{\text{hour}}) / (80 \frac{\text{sec}}{\text{cycle}})} = 0.93 \text{ veh/cycle}$

Condition C: 164' + 50' = 214'

| | |
|---|--|
| BASIS FOR COMPUTING LENGTH OF TURN LANES | 401-9E |
| | REFERENCE SECTIONS 401.6.1, 401.6.3 |

| TYPE OF TRAFFIC CONTROL | DESIGN SPEED (mph) | | | | | |
|--------------------------------------|--------------------|------|----------------|----------------|----------------|----------------|
| | 30 - 35 | | 40 - 45 | | 50 - 60 | |
| | TURN DEMAND VOLUME | | | | | |
| | HIGH | LOW* | HIGH | LOW* | HIGH | LOW* |
| SIGNALIZED | (A) | (A) | ** (B or C) | ** (B or C) | ** (B or C) | ** (B or C) |
| UNSIGNALIZED STOPPED CROSSROAD | (A) | (A) | (A) | (A) | (A) | (A) |
| UNSIGNALIZED THROUGH ROAD | (A) | (A) | (C) | (B) | ** (B or C) | (B) |

- * LOW is considered 10% or less of approach traffic volume.
- ** Whichever is greater

CONDITION (A) STORAGE ONLY

Length = 50' (diverging taper) + Storage Length (Figure 401-10)

CONDITION (B) HIGH SPEED DECELERATION ONLY

| Design Speed | Length (including 50' Diverging Taper) |
|--------------|--|
| 40 | 125 |
| 45 | 175 |
| 50 | 225 |
| 55 | 285 |
| 60 | 345 |

CONDITION (C) MODERATE SPEED DECELERATION AND STORAGE

| Design Speed | Length (including 50' Diverging Taper) |
|--------------|--|
| 40 | 111 + Storage Length (Figure 401-10) |
| 45 | 125 " |
| 50 | 143 " |
| 55 | 164 " |
| 60 | 181 " |

For Explanation, See Turn Lane Design Example

STORAGE LENGTH AT INTERSECTIONS

401-10E

REFERENCE SECTIONS
401.6.1, 401.6.3

| * AVERAGE No. OF VEHICLES/CYCLE | REQUIRED LENGTH |
|---------------------------------------|--------------------|
| 1 | 50 ft |
| 2 | 100 ft |
| 3 | 150 ft |
| 4 | 175 ft |
| 5 | 200 ft |
| 6 | 250 ft |
| 7 | 275 ft |
| 8 | 325 ft |
| 9 | 350 ft |
| 10 | 375 ft |
| 11 | 400 ft |
| 12 | 450 ft |
| 13 | 475 ft |
| 14 | 500 ft |
| 15 | 525 ft |
| 16 | 550 ft |

| * AVERAGE No. OF VEHICLES/CYCLE | REQUIRED LENGTH |
|---------------------------------------|--------------------|
| 17 | 600 ft |
| 18 | 625 ft |
| 19 | 650 ft |
| 20 | 675 ft |
| 21 | 725 ft |
| 22 | 750 ft |
| 23 | 775 ft |
| 24 | 800 ft |
| 25 | 825 ft |
| 30 | 975 ft |
| 35 | 1125 ft |
| 40 | 1250 ft |
| 45 | 1400 ft |
| 50 | 1550 ft |
| 55 | 1700 ft |
| 60 | 1850 ft |

* Average Vehicles per Cycle = $\frac{DHV (TURNING LANE)}{CYCLES/HOUR}$

If Cycles are unknown, assume:

UNSIGNALIZED OR 2 PHASE - 60 CYCLES/HR

3 PHASE - 40 CYCLES/HR

4 PHASE - 30 CYCLES/HR



**Northbound U.S. 23 Left Turn Lane Length Calculations:
ODOT Figures 401-9E & 401-10E L&D Manual Volume One**

2015 Background P.M. Peak

Design Hour Volume: 184 vehicles/hour Design Speed: 50 mph

Condition B: 225' Average vehicle/hour = $\frac{184 \text{ vehicles}}{(3600 \frac{\text{sec}}{\text{hour}}) / (90 \frac{\text{sec}}{\text{cycle}})} = 4.6 \text{ veh/cycle}$

Condition C: 143' + 200' = 343'

2015 Build P.M. Peak

Design Hour Volume: 241 vehicles/hour Design Speed: 50 mph

Condition B: 225' Average vehicle/hour = $\frac{241 \text{ vehicles}}{(3600 \frac{\text{sec}}{\text{hour}}) / (90 \frac{\text{sec}}{\text{cycle}})} = 6.025 \text{ veh/cycle}$

Condition C: 143' + 250' = 393'

2035 Background P.M. Peak

Design Hour Volume: 256 vehicles/hour Design Speed: 50 mph

Condition B: 225' Average vehicle/hour = $\frac{256 \text{ vehicles}}{(3600 \frac{\text{sec}}{\text{hour}}) / (90 \frac{\text{sec}}{\text{cycle}})} = 6.4 \text{ veh/cycle}$

Condition C: 143' + 250' = 393'

2035 Build P.M. Peak

Design Hour Volume: 313 vehicles/hour Design Speed: 50 mph

Condition B: 225' Average vehicle/hour = $\frac{313 \text{ vehicles}}{(3600 \frac{\text{sec}}{\text{hour}}) / (90 \frac{\text{sec}}{\text{cycle}})} = 7.825 \text{ veh/cycle}$

Condition C: 143' + 325' = 468'

BASIS FOR COMPUTING LENGTH OF TURN LANES

401-9E

REFERENCE SECTIONS
401.6.1, 401.6.3

| TYPE OF TRAFFIC CONTROL | DESIGN SPEED (mph) | | | | | |
|--------------------------------|--------------------|------|------------------------|------------------------|------------------------|------------------------|
| | 30 - 35 | | 40 - 45 | | 50 - 60 | |
| | TURN DEMAND VOLUME | | | | | |
| | HIGH | LOW* | HIGH | LOW* | HIGH | LOW* |
| SIGNALIZED | (A) | (A) | (B or C) ^{**} |
| UNSIGNALIZED STOPPED CROSSROAD | (A) | (A) | (A) | (A) | (A) | (A) |
| UNSIGNALIZED THROUGH ROAD | (A) | (A) | (C) | (B) | (B or C) ^{**} | (B) |

- * LOW is considered 10% or less of approach traffic volume.
- ** Whichever is greater

CONDITION (A) STORAGE ONLY

Length = 50' (diverging taper) + Storage Length (Figure 401-10)

CONDITION (B) HIGH SPEED DECELERATION ONLY

| Design Speed | Length (including 50' Diverging Taper) |
|--------------|--|
| 40 | 125 |
| 45 | 175 |
| 50 | 225 |
| 55 | 285 |
| 60 | 345 |

CONDITION (C) MODERATE SPEED DECELERATION AND STORAGE

| Design Speed | Length (including 50' Diverging Taper) | III + Storage Length (Figure 401-10) |
|--------------|--|--------------------------------------|
| 40 | | |
| 45 | 125 | ' |
| 50 | 143 | ' |
| 55 | 164 | ' |
| 60 | 181 | ' |

For Explanation, See Turn Lane Design Example

STORAGE LENGTH AT INTERSECTIONS

401-10E

REFERENCE SECTIONS
401.6.1, 401.6.3

| AVERAGE No. OF VEHICLES/CYCLE | REQUIRED LENGTH | AVERAGE No. OF VEHICLES/CYCLE | REQUIRED LENGTH |
|-------------------------------|-----------------|-------------------------------|-----------------|
| 1 | 50 ft | 17 | 600 ft |
| 2 | 100 ft | 18 | 625 ft |
| 3 | 150 ft | 19 | 650 ft |
| 4 | 175 ft | 20 | 675 ft |
| 5 | 200 ft | 21 | 725 ft |
| 6 | 250 ft | 22 | 750 ft |
| 7 | 275 ft | 23 | 775 ft |
| 8 | 325 ft | 24 | 800 ft |
| 9 | 350 ft | 25 | 825 ft |
| 10 | 375 ft | 30 | 975 ft |
| 11 | 400 ft | 35 | 1125 ft |
| 12 | 450 ft | 40 | 1250 ft |
| 13 | 475 ft | 45 | 1400 ft |
| 14 | 500 ft | 50 | 1550 ft |
| 15 | 525 ft | 55 | 1700 ft |
| 16 | 550 ft | 60 | 1850 ft |

* Average Vehicles per Cycle = $\frac{DHV (TURNING LANE)}{CYCLES/HOUR}$

If Cycles are unknown, assume:

UNSIGNALIZED OR 2 PHASE - 60 CYCLES/HR

3 PHASE - 40 CYCLES/HR

4 PHASE - 30 CYCLES/HR



**Eastbound Hills-Miller Left Turn Lane Length Calculations:
ODOT Figures 401-9E & 401-10E L&D Manual Volume One**

2015 Build P.M. Peak

Design Hour Volume: 86 vehicles/hour Design Speed: 40 mph

Condition B: 125' Average vehicle/hour = $\frac{86 \text{ vehicles}}{(3600 \frac{\text{sec}}{\text{hour}}) / (90 \frac{\text{sec}}{\text{cycle}})} = 2.15 \text{ veh/cycle}$

Condition C: 111' + 100' = 211'

2035 Build P.M. Peak

Design Hour Volume: 100 vehicles/hour Design Speed: 40 mph

Condition B: 125' Average vehicle/hour = $\frac{100 \text{ vehicles}}{(3600 \frac{\text{sec}}{\text{hour}}) / (90 \frac{\text{sec}}{\text{cycle}})} = 2.5 \text{ veh/cycle}$

Condition C: 111' + 150' = 261'

BASIS FOR COMPUTING LENGTH OF TURN LANES

401-9E

REFERENCE SECTIONS
401.6.1, 401.6.3

| TYPE OF TRAFFIC CONTROL | DESIGN SPEED (mph) | | | | | |
|--------------------------------|--------------------|------|------------|------------|------------|------------|
| | 30 - 35 | | 40 - 45 | | 50 - 60 | |
| | TURN DEMAND VOLUME | | | | | |
| | HIGH | LOW* | HIGH | LOW* | HIGH | LOW* |
| SIGNALIZED | (A) | (A) | (B or C)** | (B or C)** | (B or C)** | (B or C)** |
| UNSIGNALIZED STOPPED CROSSROAD | (A) | (A) | (A) | (A) | (A) | (A) |
| UNSIGNALIZED THROUGH ROAD | (A) | (A) | (C) | (B) | (B or C)** | (B) |

- * LOW is considered 10% or less of approach traffic volume.
- ** Whichever is greater

CONDITION (A) STORAGE ONLY

Length = 50' (diverging taper) + Storage Length (Figure 401-10)

CONDITION (B) HIGH SPEED DECELERATION ONLY

Design Speed Length (including 50' Diverging Taper)

| | |
|----|-----|
| 40 | 125 |
| 45 | 175 |
| 50 | 225 |
| 55 | 285 |
| 60 | 345 |

CONDITION (C) MODERATE SPEED DECELERATION AND STORAGE

Design Speed Length (including 50' Diverging Taper)

| | |
|----|--------------------------------------|
| 40 | 111 + Storage Length (Figure 401-10) |
| 45 | 125 |
| 50 | 143 |
| 55 | 164 |
| 60 | 181 |

For Explanation, See Turn Lane Design Example

STORAGE LENGTH AT INTERSECTIONS

401-10E

REFERENCE SECTIONS
401.6.1, 401.6.3

| AVERAGE No. OF VEHICLES/CYCLE | REQUIRED LENGTH |
|-------------------------------|-----------------|
| 1 | 50 ft |
| 2 | 100 ft |
| 3 | 150 ft |
| 4 | 175 ft |
| 5 | 200 ft |
| 6 | 250 ft |
| 7 | 275 ft |
| 8 | 325 ft |
| 9 | 350 ft |
| 10 | 375 ft |
| 11 | 400 ft |
| 12 | 450 ft |
| 13 | 475 ft |
| 14 | 500 ft |
| 15 | 525 ft |
| 16 | 550 ft |

| AVERAGE No. OF VEHICLES/CYCLE | REQUIRED LENGTH |
|-------------------------------|-----------------|
| 17 | 600 ft |
| 18 | 625 ft |
| 19 | 650 ft |
| 20 | 675 ft |
| 21 | 725 ft |
| 22 | 750 ft |
| 23 | 775 ft |
| 24 | 800 ft |
| 25 | 825 ft |
| 30 | 975 ft |
| 35 | 1125 ft |
| 40 | 1250 ft |
| 45 | 1400 ft |
| 50 | 1550 ft |
| 55 | 1700 ft |
| 60 | 1850 ft |

* Average Vehicles per Cycle = $\frac{DHV (TURNING LANE)}{CYCLES/HOUR}$

If Cycles are unknown, assume:

UNSIGNALIZED OR 2 PHASE - 60 CYCLES/HR

3 PHASE - 40 CYCLES/HR

4 PHASE - 30 CYCLES/HR



Correspondence

**A
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S**



8534 Yankee Street, Suite 2B
Dayton, Ohio 45458-1889
(937) 435-8584
www.cesoinc.com

March 19, 2015

Jennifer Stachler, P.E.
Land Development Engineer
20 E. William St.
Delaware, OH 43015

Re: Speedway US 23 and Hills Miller Road
Traffic Impact Study Review and Site Layout Comments

Dear Jennifer:

In response to the comments that were received from the City of Delaware on January 28, 2015 for the subject project, this disposition of comments has been prepared to address the comments pertaining to the traffic study and related offsite improvements.

Traffic Study and Related Offsite Improvements:

Hills Miller Road Improvements

- In our response letter dated October 16, 2014, comment #2 under site configuration comments was as follows: As we previously discussed and based on the above comments and revisions, the pavement width on Hills Miller from US 23 to the access drive will need to be widened to create a three lane section (12' lane width) in order to provide for both an eastbound left and right turn lane at the US 23-Hills Miller Intersection.

Your response letter state that an eastbound left was recommended in the report but did not address the three lane full widening. The city wishes to restate the initial requirement of a full three lane section that will extend from US 23 to the site entrance. This will be a requirement for approval. We will not, however; require a taper to the west of the site access at this time. A tapered section will be a requirement of future development to the north or west. Tapering for these improvements can be accomplished through striping.

- Your design must propose a manner of mitigation for the circulation conflict shown.

RESPONSE: Traffic study has been revised to state that the City of Delaware requires for Hills-Miller road to be widened from the western property line of the Speedway parcel to U.S. 23 creating a three lane section with 12' lane widths.

US 23 Improvements

We have received the exhibit from Mr. Leesburg showing the proposed widening of US 23. We have the following comments.

- The centerline that is shown for the new northbound left lane does not line up with the southbound lanes and there is an overlap resulting in a reduction in width of the southbound lanes. This is not acceptable and poses a safety hazard as the northbound lanes do not line

up south of the intersection. The widening must either be sifted further to the east or divided between the east and west side of US 23 in order to gain the additional pavement needed.

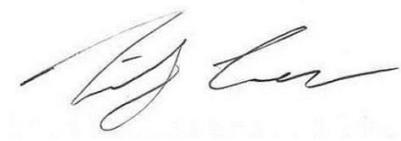
- The taper from the widened section of pavement to existing lanes is shown through the intersection. The design must be revised to show the taper occurring north of the intersection.
- Design of the shoulders shall meet the requirements shown in ODOT Table 301-2E.
- The widening of US 23 to accommodate proper lane widths will likely require removal of the barrier and guardrail that currently shield the poles that support the overhead strain wires. These wires currently hold a sign that indicates the start of the two way left turn lane. This sign is no longer appropriate for this location (due to extension of the northbound left turn lane) and will need to be relocated as part of the project. Therefore, the barrier should no longer pose a restriction on the necessary widening. The appropriate location to incorporate these signs in the new design shall be determined by the engineer. The designer shall follow current ODOT standards to determine the proper location and mounting of these signs.
- A resurfacing or microsurfacing of the areas to be striped shall be included in the budget as grinding existing pavement markings is not an acceptable method of removal.
- Appropriately designed radii are to be incorporated into the intersection design.

RESPONSE: Traffic study has been revised to state that the City of Delaware requires that U.S. 23 northbound be widened in order to accommodate a 12' northbound left turn lane to meet current ODOT standards. The remaining comments are to be addressed in the roadway design portion of the project.

Please review the above responses in conjunction with the enclosed materials. Should you have any questions, please feel free to contact our office at 937-435-8584.

Respectfully,

CESO, Inc.



Timothy J. Lowe, P.E.
Transportation Engineering Manager

Tim Lowe

From: James Leeseberg
Sent: Friday, January 30, 2015 11:53 AM
To: Tim Lowe
Subject: FW: Speedway US 23 North Traffic Study and Site Review
Attachments: 20150129153914095.pdf; 750421-WIDENING EXHIBIT-ROW North Side.pdf; Site Plan Rev 011615.PDF; TWLTL.pdf

Sorry about that. I assumed you had been.

Thanks,

Jamie

From: Jennifer Stachler [<mailto:jstachler@delawareohio.net>]
Sent: Thursday, January 29, 2015 3:56 PM
To: Christine Hilbert; James Leeseberg
Cc: Matt Weber; Jessica Ormeroid; Bill Ferrigno; dcarlin@dot.state.oh.us
Subject: Speedway US 23 North Traffic Study and Site Review

Christine and Jamie,

Attached is the final review letter for the study and comments regarding the recent site layout submission. I have also attached the widening exhibit that was submitted as well as the latest site plan. The 4th attachment is the standard drawing for the required striping of the two way turn lane.

I believe we are finally close to being able to consider the study completed and moving forward with design. I will leave it up to the folks in your camp to decide whether a meeting to discuss these final parameters is necessary. If you would like to set one up, please let me know and I will get it scheduled as soon as possible.

I am also touching base with ODOT to make sure they are comfortable with the proposed improvements and feel all their concerns have been met.

Again, I thank you both for your time and patience in this process and look forward to the next steps.

Sincerely,

Jennifer Stachler, P.E.
Land Development
Public Works Department- Division of Engineering Services
20 E. William St.
Delaware, OH 43015
740-203-1711
jstachler@delawareohio.net

This message may contain confidential and/or proprietary information and is intended for the person/entity to whom it was originally addressed. Any use by others is strictly prohibited.



CITY OF DELAWARE

January 28, 2015

Ms. Christine Hilbert
Transportation Project Manager
CESO, Inc
8534 Yankee Street, Suite 2B
Dayton, OH 45458-1889

RE: Speedway US 23 and Hills Miller Road
Traffic Impact Study Review and Site Layout Comments

Ms. Hilbert:

As a follow up to your submission of the traffic study and the additional correspondence regarding the study parameters we offer the following final comments.

It is our understanding, as stated in the summary, that you have provided copies of the study to the Ohio Department of Transportation and Delaware County and successfully addressed all of their comments in the designs you have put forward.

Traffic Study and Related Offsite Improvements:

Hills Miller Road Improvements:

- In our response letter dated October 16, 2014, comment #2 under site configuration comments was as follows: *As we previously discussed and based on the above comments and revisions, the pavement width on Hills Miller from US 23 to the access drive will need to be widened to create a three lane section (12' lane width) in order to provide for both an eastbound left and right turn lane at the US23-Hills Miller Intersection.*

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- Your design must propose a manner of mitigation for the circulation conflict shown.

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- The taper from the widened section of pavement to existing lanes is shown through the intersection. The design must be revised to show the taper occurring north of the intersection.
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CITY OF DELAWARE

location to incorporate these signs in the new design shall be determined by the engineer. The designer shall follow current ODOT standards to determine the proper location and mounting of these signs.

- A resurfacing or microsurfacing of the areas to be striped shall be included in the budget as grinding existing pavement markings is not an acceptable method of removal.
- Appropriately designed radii are to be incorporated into the intersection design.

Site Layout:

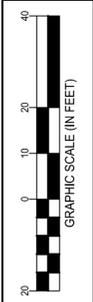
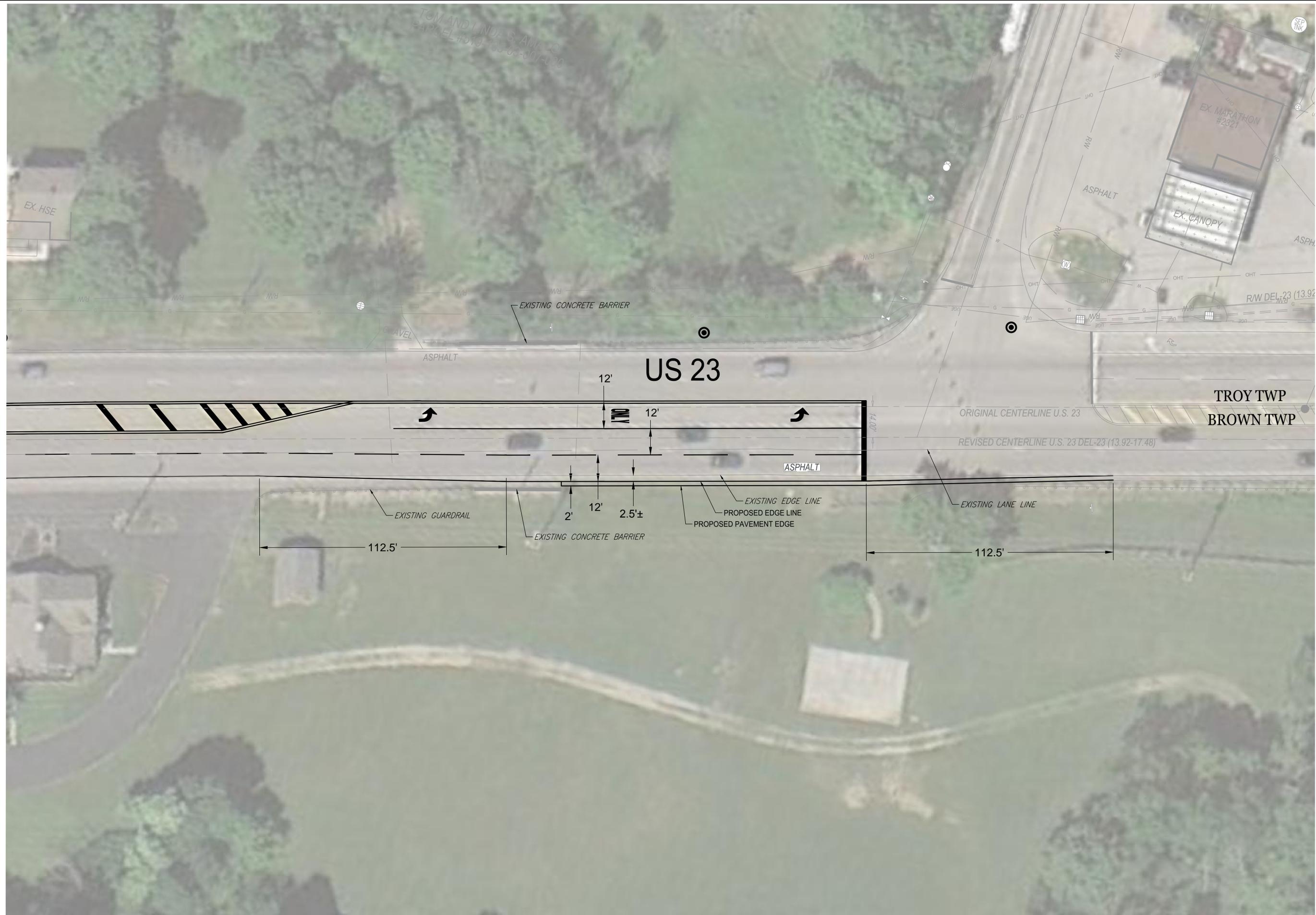
- The revised site layout appears to have addressed the City's comments to the best extent possible.
- The proposed layout is acceptable with the addition of some directional striping that we hope will further clarify the intended paths for trucks and passenger vehicles. Please see the attached redline sketch.
- All striping shall be thermoplastic and per COC specification 644
- An exhibit and description shall be produced that describes the access drive off of Hills Miller and the drive that extends from the RIRO off of US 23 to this drive. A deed of easement shall then be written and signed by both Speedway representatives and a representative of the property owner to the north. This easement shall be an access easement and shall be recorded with Delaware County.

Provide an exhibit showing all proposed improvements on Hills Miller and US 23 based on compliance with the comments above. Once this exhibit is presented and reviewed and we have confirmed that ODOT's satisfaction with what has been proposed, we shall consider the study complete and work can commence on final design for both roadway enhancements and proposed sitework.

Sincerely,

A handwritten signature in blue ink, appearing to read "Jennifer S. Stachler".

Jennifer S. Stachler, P.E.
Land Development Engineer
City of Delaware



CALCULATED
 [CALC'D]
 CHECKED
 [CHK'D]

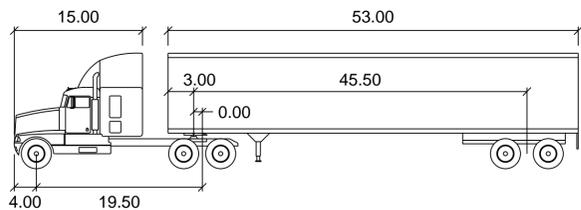
PROPOSED US 23 NORTH SIDE WIDENING
HILLS MILLER RD. & US 23

SPEEDWAY #100359
 DELAWARE, OH



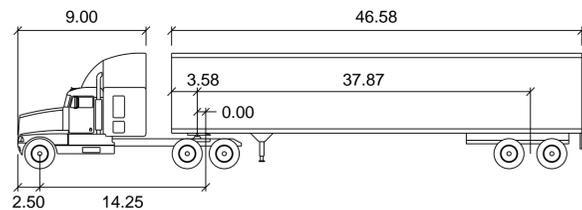
LEGEND

- 1 FT OFFSET FROM FACE OF CURB
- 5 FT OFFSET FROM FACE OF CURB
- CIRCULATION CONFLICT AREA



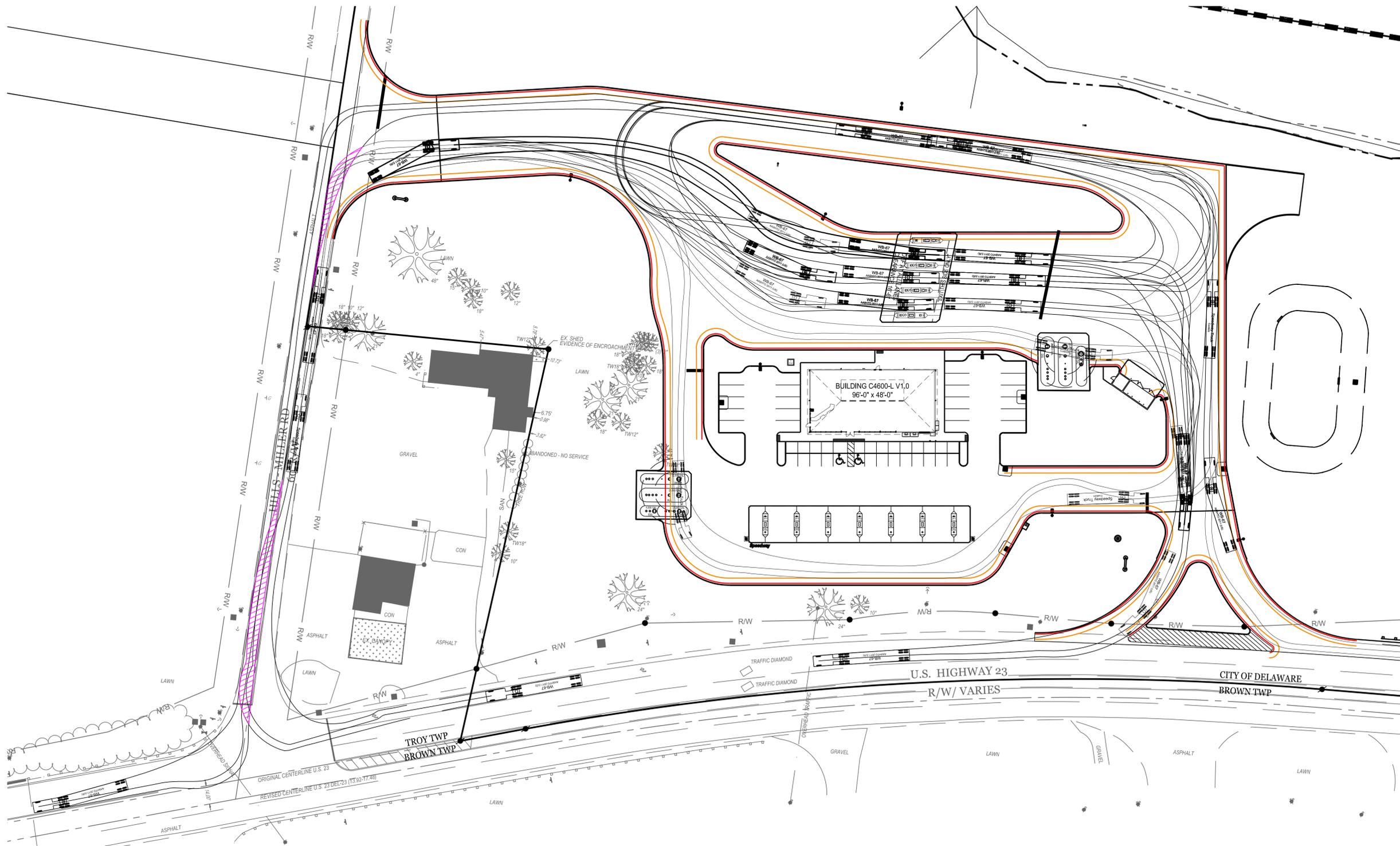
WB-67

| | | | |
|---------------|--------|--------------------|--------|
| Tractor Width | : 8.00 | Lock to Lock Time | : 6.0 |
| Trailer Width | : 8.50 | Steering Angle | : 28.4 |
| Tractor Track | : 8.00 | Articulating Angle | : 75.0 |
| Trailer Track | : 8.50 | | |



FUEL - SPEEDWAY

| | | | |
|---------------|--------|--------------------|--------|
| Tractor Width | : 9.00 | Lock to Lock Time | : 6.0 |
| Trailer Width | : 8.00 | Steering Angle | : 26.0 |
| Tractor Track | : 8.00 | Articulating Angle | : 60.0 |
| Trailer Track | : 8.00 | | |



| NO. | DATE | REVISIONS | DESIGNER | DATE | REVIEWER | DATE |
|-----|----------|-----------------------------------|------------|----------|----------|----------|
| 1 | 05/02/14 | ISSUED FOR SUBMITTAL | C. WARSHAW | 05/02/14 | B. WITT | 05/02/14 |
| 2 | 05/02/14 | REVISED PER NATIONAL PRESENTATION | C. WARSHAW | 05/02/14 | B. WITT | 05/02/14 |
| 3 | 05/02/14 | REVISED PER SPEEDWAY REVIEW | C. WARSHAW | 05/02/14 | B. WITT | 05/02/14 |
| 4 | 05/02/14 | REVISED PER LAYOUT | C. WARSHAW | 05/02/14 | B. WITT | 05/02/14 |
| 5 | 05/02/14 | REVISED PER LAYOUT | C. WARSHAW | 05/02/14 | B. WITT | 05/02/14 |

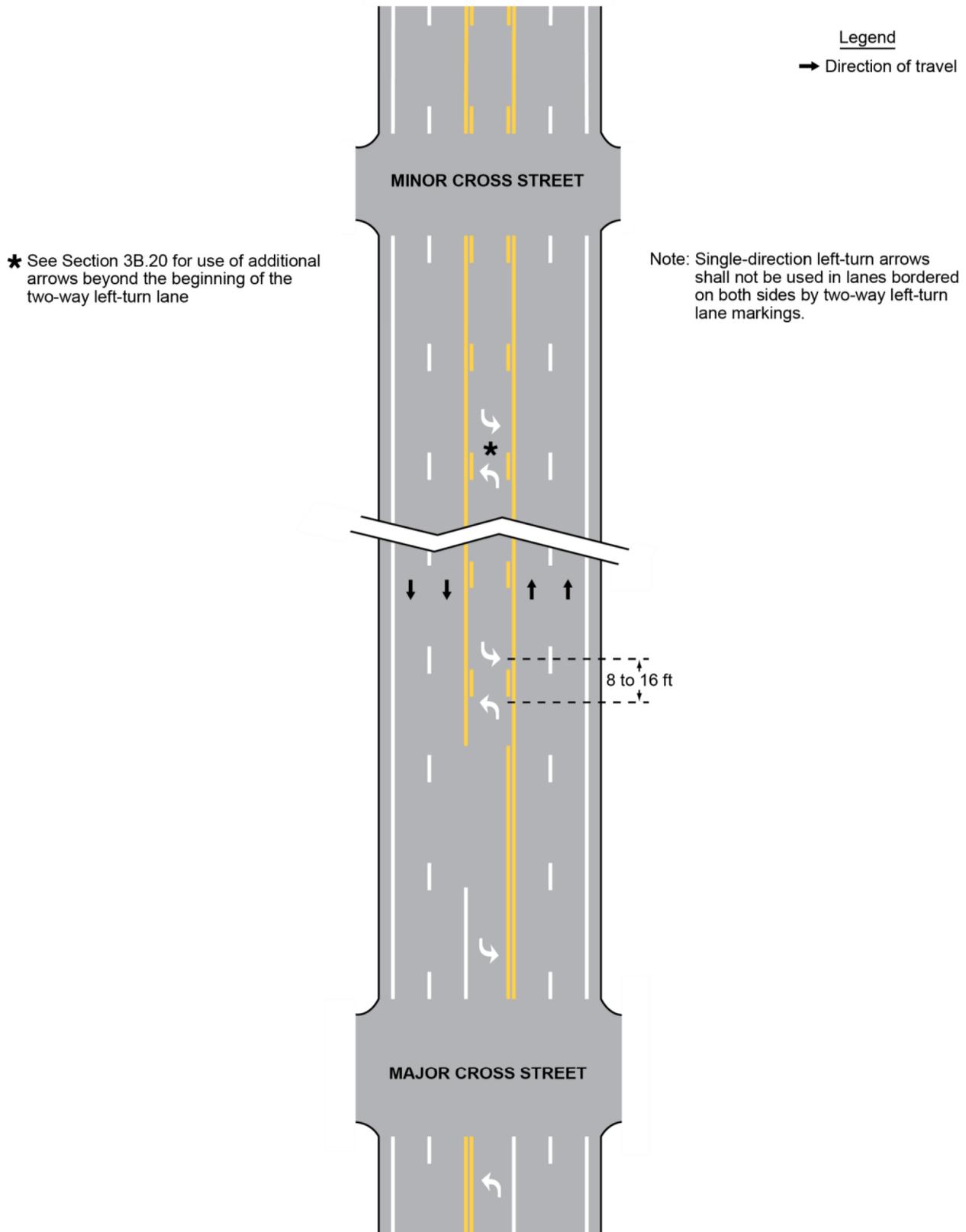
CIRCULATION PLAN
NEW BUILD
 2319 US HWY. 23 N
 DELAWARE COUNTY
 DELAWARE, OH

STORE OR BLDG NO. **7775**
 VERSION OR ID NO. **137129**
 SCALE 0 20 40
 GRAPHIC SCALE IN FEET

| DESIGN TEAM | DATE |
|------------------|----------|
| DGNR. C. WARSHAW | 05/02/14 |
| P.MGR. B. WITT | 05/02/14 |
| R.WR. R. MATKO | 05/02/14 |

DRWG. NO. **7775-CR**

Figure 3B-7. Example of Two-Way Left-Turn Lane Marking Applications



Tim Lowe

From: Christine Hilbert
Sent: Tuesday, December 16, 2014 4:41 PM
To: Tim Lowe
Subject: FW: Speedway Development US 23 and Hills Miller Road
Attachments: 20141216140412559.pdf

Christine Hilbert
Transportation Project Manager



CESO, Inc.
8534 Yankee Street, Suite 2B, Dayton, Ohio 45458-1889
P: (937) 435-8584 Ext. 1133 | **F:** (937) 435-3307
C: (937) 776-7183
Email: hilbert@cesoinc.com | **Website:** www.cesoinc.com

From: Jennifer Stachler [<mailto:jstachler@delawareohio.net>]
Sent: Tuesday, December 16, 2014 2:26 PM
To: Christine Hilbert
Cc: Matt Weber; Jessica Ormeroid; Bill Ferrigno; Marion Stephen
Subject: Speedway Development US 23 and Hills Miller Road

Christine,

I hope you are well. Please see the attached letter in response to the latest submission of the traffic study for the above referenced project.

This should be considered the City's final response to the study. Please let us know if we can answer any further questions or if there is a need to meet to discuss any of the design parameters that we have not covered to date.

I appreciate your time and patience and we look forward to working with you.

Sincerely,
Jennifer Stachler, P.E.
Land Development
Public Works Department- Division of Engineering Services
20 E. William St.
Delaware, OH 43015
740-203-1711
jstachler@delawareohio.net



CITY OF DELAWARE

December 12, 2014

Ms. Christine Hilbert
Transportation Project Manager
CESO, Inc
8534 Yankee Street, Suite 2B
Dayton, OH 45458-1889

RE: Speedway US 23 and Hills Miller Road
Traffic Impact Study Review

Ms. Hilbert:

We received your traffic study dated November 5, 2014 and have the following comments. Please note that all improvements recommended by the study will need to be constructed by opening day. The Synchro analysis provided shows both the eastbound right and left turn queues extending past the site access point which is greater than the 200 foot length recommended for the eastbound left turn lane. The study shall be revised to recommend a length consistent with the Synchro analysis queues.

The recommendation to avoid lengthening the northbound left turn lane onto Hills Miller is understood and the city is in agreement with this suggestion. It will be necessary, however, to perform restriping work to bring this lane into conformance with OMUTCD figure 3B-7. This will provide the proper lane markings to permit northbound left stacking past the dedicated lane storage during peak hours.

The city has determined that widening of the northbound left turn lane on US23 will be a requirement for approval of this plan. The City will work with Speedway's designers to determine the best possible method for providing the additional pavement necessary to make this lane a safe width for the travelling public.

The final design of the project shall incorporate all items discussed above.

Sincerely,

A handwritten signature in blue ink that reads "Jennifer S. Stachler". The signature is fluid and cursive, with a long horizontal line extending to the right.

Jennifer S. Stachler, P.E.
Land Development Engineer
City of Delaware



8534 Yankee Street, Suite 2B
Dayton, Ohio 45458-1889
(937) 435-8584
www.cesoinc.com

November 5, 2014

Jennifer Stachler, P.E.
Land Development Engineer
20 E. William St.
Delaware, OH 43015

Re: US 23 and Hills Miller Road Traffic Impact Study

Dear Jennifer:

In response to the comments that were received from the City of Delaware on Friday October 17, 2014 for the subject project, this disposition of comments has been prepared.

Synchro Analysis Comments: (No Build and Build Conditions):

1. The heavy truck percentage needs to be revised for both US 23 and Hills Miller Road. These percentages should be derived from the 24 hour counts that were obtained. The build conditions for Hills Miller Road must account for the additional truck traffic that will be added with the development. On US 23 the city would accept an average heavy truck percentage of 10% if you would prefer not to perform the calculations.

RESPONSE: An average heavy truck percentage of 10% was used for vehicles traveling through on US 23.

2. The northbound left and eastbound movements shall not be set to “max” recall. They shall both be set to “none” since both are “actuated only” movements. In addition, the US 23 through movements shall be set to minimum recall given the fact that there are extensions loops in place to extend the green with traffic demand.

RESPONSE: Recall for northbound left and eastbound movements was set to “none”. All other movements were set to “minimum” recall.

3. As discussed in the MOU meeting, an 80 second cycle length shall be used for the AM and a 90 second cycle length shall be used for the PM. This will work well with future coordination plans that will be implemented along this corridor.

RESPONSE: Cycle lengths were adjusted to 80 seconds for the AM peak hour and 90 seconds for the PM peak hour.

4. Please note the City of Delaware's Chapter 8, TIS Standard:
Level-of-service (LOS) criteria: It is the goal of the City of Delaware to maintain a LOC C or better for the 24- hour period and LOS D or better during the peak traffic hours for the operation of all roadways. In any area where the current level of service is C or worse for a 24-hour period or D or worse during peak hours, this baseline level of service must be maintained or improved after development.

RESPONSE: Synchro analysis with recommended improvements maintains a LOS D or better during AM and PM peak hours.

When revising the Synchro analysis after addressing all comments provided, please ensure that the above Chapter 8, TIS standard is adhered to and appropriate improvements are proposed. Please note that the LOS requirement above is for the "operation of all roadways" not just the intersection. This is especially important for the Hills Miller Road approach and the northbound left movement.

General TIS Comments:

1. The report needs to clearly identify ADT on US23 at this location and this roadway's classification as a principal arterial. Commentary contrasting this ADT and traffic volumes at I-71 and US 36 shall be included in the report as these two locations were incorrectly compared at the town hall meeting.

RESPONSE: The ADT on US 23 and roadway's classification as a principal arterial were noted in the report. Commentary was added clarifying the differences between the proposed site and the existing truck stops on US 36 adjacent to I-71. The ADT for US 36 and I-71 were obtained from MORPC and noted in the report.

2. Though the 1% growth rate was directed as part of the MOU, validate its use through recent practice of ODOT/ MORPC in a similar study.

RESPONSE: A growth rate of 1.7% was used based on discussions between City of Delaware and James Leeseberg of CESO Inc. Please specify similar study using this growth rate.

3. It appears that the distributions on US23 are opposite from what they should be for both the AM and PM period. The intended distribution is listed below and all pass-by and site traffic shall be revised to match this distribution.

- AM: 15% from Hills Miller: 35% from south US23 : 50% from north US23
- PM: 15% from Hills Miller: 50% from south US23 : 35% from north US23

RESPONSE: The directional distribution of traffic going to/from the site was changed to reflect the above distribution.

4. It is unclear how the pass-by trips are redistributed into the network. Please clarify and ensure all pass-by trips coming from the site back to the roadway network are accounted for and properly distributed (i.e. pass-by trucks traveling southbound will probably utilize the signal as opposed to RIRO when leaving the site). Please also ensure pass-by trips are not subtracted out of the background traffic more than once.

RESPONSE: Additional figures were added showing the distribution of traffic going in and out of the study area in the AM and PM peak hours. As requested, pass-by trucks traveling southbound were shown as utilizing the signal instead of the RIRO when leaving the site.

5. Please use SIM Traffic to run a queuing analysis for the build conditions for the US23-Hills Miller Road Intersection. The queuing analysis shall be utilized to determine the proper northbound left turn lane length and ensure that the eastbound movement doesn't back up and block the site drive.

RESPONSE: SimTraffic was used to determine the queues formed for build conditions for the US 23 and Hills Miller Road Intersection. Recommendations for the northbound left turn lane were made based on the queuing analysis. Queuing analysis also showed that the eastbound movements from Hills Miller Road do not back up and block the site drive.

6. Please provide a detailed exhibit of the existing intersection with all current lane and shoulder widths clearly shown. This exhibit could perhaps serve as the base drawing for an autoturn exhibit that shows the encroachment of wider vehicles into other lanes (both turning vehicles and possible sideswipe conditions). The intent is to demonstrate the constraints of the current roadway system to accommodate an even greater volume of trucks and larger vehicles.

RESPONSE: Existing lane width exhibit was modified to show the existing lane and shoulder widths at all three approaches to the US 23 and Hills Miller Road intersection

Site Configuration Comments:

1. In the initial development meeting the city and ODOT discussed the fact that this area is part of the US23 access management plan and the plan calls for a rear access road. Although the concept plan that was submitted allows for connection to the west, the road/drive shown is clearly incorporated into the main speedway circulation area. The intention of the backage road to function separately from the individual commercial uses is lost when incorporated into the parking/ circulation areas as it is here. While we understand the constraints of stream setbacks and other neighborhood concerns, we must preserve the integrity of the future transportation network in this area. The design shall be revised to incorporate increased separation between the access road and Speedway clientele traffic.

RESPONSE: City of Delaware staff is working with James Leeseberg regarding this issue. Per City of Delaware TIS comments, Synchro analyses are based upon all trucks exiting site are utilizing Hills Miller Road.

2. As we previously discussed and based on the above comments and revisions, the pavement width on Hills Miller from US 23 to the access drive will need to be widened to create a three lane section (12' lane width) in order to provide for both an eastbound left and right turn lane at the US23-Hills Miller Intersection.

RESPONSE: In order to maintain a LOS D or better during peak hours, a dedicated eastbound left turn lane was recommended in the report. Item noted and is to be addressed in roadway design portion of project.

3. The radii at the northwest and southwest corner of US23 Hills Miller Road will need improved to accommodate turning movements of a WB-67. Based on the exhibit on page 9 showing the truck turning movements, it doesn't appear the existing pavement width and radii can accommodate these movements without trucks encroaching on the opposing travel lanes. In addition to the eastbound and southbound right movements, the northbound left truck turning movement will need to be analyzed and shown in this exhibit.

RESPONSE: Item reviewed. Additional right-of-way needed to accommodate WB-67 movements. Speedway is working to acquire necessary right-of-way. Item is to be addressed in roadway design portion of project.

4. At Hills Miller and the access drive, the proposed radii at the northwest and northeast corners shall be able to accommodate WB-67 truck turning movements without the trucks encroaching into the opposing travel lanes.

RESPONSE: Item noted and is to be addressed in site design portion of project.

5. As previously discussed in our conference call on September 11th, the city conducted pavement cores along Hills Miller Road. It was found that the pavement section on Hills Miller Road is not adequate to withstand the additional truck traffic that will be drawn to this development. Improvements to the roadway pavement section will be required as part of the project approvals.

RESPONSE: Item noted and is to be addressed in roadway design portion of project.

6. The existing 10 foot northbound left turn lane and the 11 foot northbound and southbound inside through lanes are substandard and do not safely accommodate large trucks traveling side-by-side especially in opposing directions at a 50 mph design speed. Given that the northbound left turn lane will need to accommodate a heavy volume of large trucks, these lane widths will need to be improved to meet ODOT standards. The city's ladder truck has an overall width measurement at its largest point of 120 inches or 10 feet. Our tandem axle dump trucks are only slightly less than this width. As you can see, the existing lane widths cannot accommodate vehicles of this size when placed side by side with truck traffic.

RESPONSE: Item noted and discussed on September 11th conference call. It is agreed that the existing conditions are substandard. However, we do not consider three (3) additional trucks to be a heavy volume. In addition, the substandard nature of the lane is not a result of the proposed Speedway.

Please review the above responses in conjunction with the enclosed materials. Should you have any questions, please feel free to contact our office at 937-435-8584.

Respectfully,

CESO, Inc.

Encl.



CITY OF DELAWARE

October 16, 2014

Ms. Christine Hilbert
Transportation Project Manager
CESO Inc
8534 Yankee St. Suite 2B
Dayton, OH 45458-1889

RE: US 23 and Hills Miller Road
Traffic Impact Study

Ms. Hilbert,

I am writing to summarize comments on the traffic impact study that was submitted to the city on July 2, 2014. Due to the location of this development and the residential uses in close proximity, we want to ensure that we are very detailed in our analysis of the traffic needs of this area. Therefore, the process may appear to be moving slower than other projects you may have been involved with. We appreciate your patience in this ongoing review and hope to come to a conclusion in regard to the necessary roadway improvements for this development soon.

Our comments regarding your submission are as follows:

Synchro Analysis Comments: (No Build and Build Conditions):

1. The heavy truck percentage needs to be revised for both US 23 and Hills Miller Road. These percentages should be derived from the 24 hour counts that were obtained. The build conditions for Hills Miller Road must account for the additional truck traffic that will be added with the development. On US 23 the city would accept an average heavy truck percentage of 10% if you would prefer not to perform the calculations.
2. The northbound left and eastbound movements shall not be set to "max" recall. They shall both be set to "none" since both are "actuated only" movements. In addition, the US 23 through movements shall be set to minimum recall given the fact that there are extensions loops in place to extend the green with traffic demand.
3. As discussed in the MOU meeting, an 80 second cycle length shall be used for the AM and a 90 second cycle length shall be used for the PM. This will work well with future coordination plans that will be implemented along this corridor.
4. Please note the City of Delaware's Chapter 8, TIS Standard:
Level-of-service (LOS) criteria: It is the goal of the City of Delaware to maintain a LOC C or better for the 24-hour period and LOS D or better during the peak traffic hours for the operation of all roadways. In any area where the current level of service is C or worse for a 24-hour period or D or worse during peak hours, this baseline level of service must be maintained or improved after development.

When revising the Synchro analysis after addressing all comments provided, please ensure that the above Chapter 8, TIS standard is adhered to and appropriate improvements are proposed. Please note that the LOS requirement above is for the "operation of all roadways" not just the intersection. This is especially important for the Hills Miller Road approach and the northbound left movement.

General TIS Comments:

1. The report needs to clearly identify ADT on US23 at this location and this roadway's classification as a principal arterial. Commentary contrasting this ADT and traffic volumes at I-71 and US 36 shall be included in the report as these two locations were incorrectly compared at the town hall meeting.
2. Though the 1% growth rate was directed as part of the MOU, validate its use through recent practice of ODOT/MORPC in a similar study.
3. It appears that the distributions on US23 are opposite from what they should be for both the AM and PM period. The intended distribution is listed below and all pass-by and site traffic shall be revised to match this distribution.
 - **AM:** 15% from Hills Miller: 35% from south US23 : 50% from north US23
 - **PM:** 15% from Hills Miller: 50% from south US23 : 35% from north US23
4. It is unclear how the pass-by trips are redistributed into the network. Please clarify and ensure all pass-by trips coming from the site back to the roadway network are accounted for and properly distributed (i.e. pass-by trucks traveling southbound will probably utilize the signal as opposed to RIRO when leaving the site). Please also ensure pass-by trips are not subtracted out of the background traffic more than once.



CITY OF DELAWARE

5. Please use SIM Traffic to run a queuing analysis for the build conditions for the US23-Hills Miller Road Intersection. The queuing analysis shall be utilized to determine the proper northbound left turn lane length and ensure that the eastbound movement doesn't back up and block the site drive.
6. Please provide a detailed exhibit of the existing intersection with all current lane and shoulder widths clearly shown. This exhibit could perhaps serve as the base drawing for an autoturn exhibit that shows the encroachment of wider vehicles into other lanes (both turning vehicles and possible sideswipe conditions). The intent is to demonstrate the constraints of the current roadway system to accommodate an even greater volume of trucks and larger vehicles.

Site Configuration Comments:

1. In the initial development meeting the city and ODOT discussed the fact that this area is part of the US23 access management plan and the plan calls for a rear access road. Although the concept plan that was submitted allows for connection to the west, the road/drive shown is clearly incorporated into the main speedway circulation area. The intention of the backage road to function separately from the individual commercial uses is lost when incorporated into the parking/ circulation areas as it is here. While we understand the constraints of stream setbacks and other neighborhood concerns, we must preserve the integrity of the future transportation network in this area. The design shall be revised to incorporate increased separation between the access road and Speedway clientele traffic.
2. As we previously discussed and based on the above comments and revisions, the pavement width on Hills Miller from US 23 to the access drive will need to be widened to create a three lane section (12' lane width) in order to provide for both an eastbound left and right turn lane at the US23-Hills Miller Intersection.
3. The radii at the northwest and southwest corner of US23 Hills Miller Road will need improved to accommodate turning movements of a WB-67. Based on the exhibit on page 9 showing the truck turning movements, it doesn't appear the existing pavement width and radii can accommodate these movements without trucks encroaching on the opposing travel lanes. In addition to the eastbound and southbound right movements, the northbound left truck turning movement will need to be analyzed and shown in this exhibit.
4. At Hills Miller and the access drive, the proposed radii at the northwest and northeast corners shall be able to accommodate WB-67 truck turning movements without the trucks encroaching into the opposing travel lanes.
5. As previously discussed in our conference call on September 11th, the city conducted pavement cores along Hills Miller Road. It was found that the pavement section on Hills Miller Road is not adequate to withstand the additional truck traffic that will be drawn to this development. Improvements to the roadway pavement section will be required as part of the project approvals.
6. The existing 10 foot northbound left turn lane and the 11 foot northbound and southbound inside through lanes are substandard and do not safely accommodate large trucks traveling side-by-side especially in opposing directions at a 50 mph design speed. Given that the northbound left turn lane will need to accommodate a heavy volume of large trucks, these lane widths will need to be improved to meet ODOT standards. The city's ladder truck has an overall width measurement at its largest point of 120 inches or 10 feet. Our tandem axle dump trucks are only slightly less than this width. As you can see, the existing lane widths cannot accommodate vehicles of this size when placed side by side with truck traffic.

The design standards for this section of US23 must follow the lane width and shoulder criteria for a rural arterial roadway with a design year ADT>2000 from the ODOT L&D Manual. As can be observed by data in this study, this section of US 23 has a relatively high accident rate. The City cannot allow additional development that will exacerbate the problem without proper roadway improvements that will properly accommodate the traffic to and from this development.

Please feel free to call us if you have questions or we can set up a meeting to discuss in greater detail.

Sincerely,

Jennifer Stachler, P.E.
Land Development Engineer

Tim Lowe

From: James Leeseberg
Sent: Friday, August 22, 2014 10:41 AM
To: Nicholas Hershberger; Chris Warshaw; Tim Lowe
Subject: Fwd: Speedway Development US 23 & Hills-Miller Road

FYI

Sent from my Verizon Wireless 4G LTE Smartphone

----- Forwarded message -----

From: "Jennifer Stachler" <jstachler@delawareohio.net>
To: "Christine Hilbert" <hilbert@cesoinc.com>
Cc: "Matt Weber" <mweber@delawareohio.net>, "James Leeseberg" <leeseberg@cesoinc.com>
Subject: Speedway Development US 23 & Hills-Miller Road
Date: Fri, Aug 22, 2014 10:11 AM

You had it correct, we believe the additional traffic created by this use will create a need for an eastbound left turn lane at the Hills Miller / US 23 intersection (with the lane configuration being southbound right turn onto Hills Miller, eastbound . We need to take a closer look at how that works with an eastbound left in into the station access.

Another quick note, we performed some in-house cores on this pavement at this intersection and found that the pavement is very soft and porous. We are quite certain that this pavement will not hold up to the extreme weight of truck traffic therefore, the developer should be taking reconstruction of this area into account when preparing estimates.

Thanks,

Jennifer Stachler, P.E.
Land Development
Public Works Department- Division of Engineering Services
20 E. William St.
Delaware, OH 43015
740-203-1711
jstachler@delawareohio.net

From: Christine Hilbert [mailto:hilbert@cesoinc.com]
Sent: Friday, August 22, 2014 9:44 AM
To: Jennifer Stachler
Subject: RE: Speedway Development US 23 & Hills-Miller Road

Jennifer,

Good morning. Thank you for your phone call yesterday, I just want to make sure I understand about the widening on Hills-Miller Road. Is the City requesting the widening of Hills-Miller Road to create an additional eastbound lane at the intersection of Hills-Miller Road and US 23? After our discussion, I got to thinking maybe the additional lane on Hills-

Miller Road was at the proposed Speedway driveway but that is not how I understood the phone call. I thought I should contact you just so that I had everything correct in my mind.

Thank you very much for your assistance & I hope you have a great weekend.

Christine Hilbert
Transportation Project Manager



CESO, Inc.
8534 Yankee Street, Suite 2B, Dayton, Ohio 45458-1889
P: (937) 435-8584 Ext. 1133 | **F:** (937) 435-3307
C: (937) 776-7183
Email: hilbert@cesoinc.com | **Website:** www.cesoinc.com

From: Jennifer Stachler [mailto:jstachler@delawareohio.net]
Sent: Monday, August 11, 2014 2:20 PM
To: Christine Hilbert
Cc: Matt Weber; Jessica Ormeroid; Tim Lowe; James Leeseberg
Subject: RE: Speedway Development US 23 & Hills-Miller Road

Hi Christine,

Our sincerest apologies about the delay in completing the review. Jessica has taken another position and has several items of work to finish prior to leaving. We are working on determining who will be completing the review in her absence. I will get back with you as soon as I have an approximate date for completion.

Thanks,

Jennifer Stachler, P.E.
Land Development
Public Works Department- Division of Engineering Services
20 E. William St.
Delaware, OH 43015
740-203-1711
jstachler@delawareohio.net

From: Christine Hilbert [mailto:hilbert@cesoinc.com]
Sent: Monday, August 11, 2014 10:54 AM
To: Jennifer Stachler
Cc: Matt Weber; Jessica Ormeroid; Tim Lowe; James Leeseberg
Subject: FW: Speedway Development US 23 & Hills-Miller Road

Jennifer,

I sent the e-mail below to Jessica Ormeroid last week concerning the status of the review of the TIS for the subject project. After I sent it to her, I realized I should be contacting you about these matters (unless you tell me otherwise) since the Speedway project is a Land Development project.

I am being told by the Project Manager that the preliminary site meeting cannot be set up until the TIS is reviewed & approved. Can you give me a status update of when you expect the TIS review to be complete & comments returned to CESO?

Thank you for any information you can provide.

Christine Hilbert
Transportation Project Manager



CESO, Inc.
8534 Yankee Street, Suite 2B, Dayton, Ohio 45458-1889
P: (937) 435-8584 Ext. 1133 | **F:** (937) 435-3307
C: (937) 776-7183
Email: hilbert@cesoinc.com | **Website:** www.cesoinc.com

From: Christine Hilbert
Sent: Tuesday, August 05, 2014 9:05 AM
To: Jessica Ormeroid (jormeroid@delawareohio.net)
Cc: jstachler@delawareohio.net; Matt Weber (mweber@delawareohio.net); James Leeseberg; Tim Lowe
Subject: FW: Speedway Development US 23 & Hills-Miller Road

Jessica,

Good morning. Can you give me a status update of the City's review of the TIS for the subject project? The original TIS was submitted on 7/2/14 with additional information submitted on 7/14/14. Prior to the site meeting being scheduled the TIS needs to be reviewed & approved.

Thank you for any information you can provide.

Christine Hilbert
Transportation Project Manager



CESO, Inc.
8534 Yankee Street, Suite 2B, Dayton, Ohio 45458-1889
P: (937) 435-8584 Ext. 1133 | **F:** (937) 435-3307
C: (937) 776-7183
Email: hilbert@cesoinc.com | **Website:** www.cesoinc.com

From: Christine Hilbert
Sent: Monday, July 14, 2014 3:32 PM
To: Jessica Ormeroid (jormeroid@delawareohio.net)
Cc: 'Jennifer.Hasley@dot.state.oh.us'; Matt Weber (mweber@delawareohio.net); Tim Lowe
Subject: FW: Speedway Development US 23 & Hills-Miller Road

Jessica,

In response to your e-mail below dated 7/2/14 the following items are attached. Two hard copies will be sent in along with a CD of the Revised Synchro analysis.

- Traffic Volume Maps for 2015 Am & Pm & 2035 AM & PM
- Revised Synchro Reports for 2015 Build & No Build; 2035 Build & No-Build
- Pages from ITE Handbook documenting percentage of by-pass trips
- An e-mail from Speedway discussing how they came up with the truck trips.

- A narrative with the truck trips entering & exiting the site.
- A site plan with fueling stations called out. Make note that only 3 semis can fuel at one time. A semi usually fills up using 2 fueling positions since there are gas/diesel tanks on each side of the tractor/trailer. There is also only enough room for 3 semis to be at this fueling area at one time.

Please let me know if you require additional information. The hard copies will be put in the mail today.

Christine Hilbert
Transportation Project Manager



CESO, Inc.
8534 Yankee Street, Suite 2B, Dayton, Ohio 45458-1889
P: (937) 435-8584 Ext. 1133 | F: (937) 435-3307
C: (937) 776-7183
Email: hilbert@cesoinc.com | Website: www.cesoinc.com

From: Jessica Ormeroid [<mailto:JOrmeroid@delawareohio.net>]
Sent: Wednesday, July 02, 2014 8:55 AM
To: Christine Hilbert
Cc: Jennifer Stachler; Matt Weber
Subject: RE: Speedway Development US 23 & Hills-Miller Road

Christine,

In order to complete our first review of the TIS, we will need the following information to be included in the report and questions answered:

- 1) Revise the traffic volume maps per our TIS standards, see below:
6. **Opening Year Traffic Volumes Map** – use $A + B + C + D = \text{Total}$ diagram where A is opening year background traffic, B is other site traffic (if applicable), C is site pass by traffic, D is site traffic
7. **Design Year Traffic Volumes Map** – use $A + B + C + D = \text{Total}$ diagram where A is design year background traffic, B is other site traffic (if applicable), C is site pass by traffic, D is site traffic
- 2) Provide the pdf of the sheets from the Trip Generation Handbook documenting the percentage of pass-by trips and provide your assumptions of which access these pass-by trips use when leaving the site. In the report, ensure that the pass-by trips are added back into the corresponding volumes on both Hills Miller Road and US23.
- 3) Provide the existing and anticipated truck percentage increase with the development for Hills Miller Road.
- 4) Verify there are only 17 fueling positions.

I have also attached our TIS standards for your reference. Please let me know if you have any questions.

Thanks,

Jessica A. Ormeroid, PE, PTOE
Project Engineer II

City of Delaware, Ohio
Public Works Department – Division of Engineering Services
440 East William Street
Delaware, Ohio 43015
(740)203-1724 Office
(740)203-1749 Fax

From: Jennifer Stachler
Sent: Monday, June 30, 2014 11:10 AM
To: Matt Weber; Jessica Ormeroid
Subject: FW: Speedway Development US 23 & Hills-Miller Road

Jennifer Stachler, P.E.
Land Development
Public Works Department- Division of Engineering Services
20 E. William St.
Delaware, OH 43015
740-203-1711
jstachler@delawareohio.net

From: Christine Hilbert [<mailto:hilbert@cesoinc.com>]
Sent: Monday, June 30, 2014 10:54 AM
To: Jennifer Stachler
Cc: dcarlin@dot.state.oh.us; jpiccin@co.delaware.oh.us; mlove@co.delaware.oh.us; James Leeseberg; Tim Lowe
Subject: Speedway Development US 23 & Hills-Miller Road

Jennifer,

Attached is the TIS for the subject project. If you would like hard copies or require additional information, please contact me.

Thank you for your assistance in this project.

Christine Hilbert
Transportation Project Manager



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8534 Yankee Street, Suite 2B, Dayton, Ohio 45458-1889
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Tim Lowe

From: Christine Hilbert
Sent: Thursday, July 03, 2014 12:38 PM
To: Tim Lowe
Subject: Speedway Development US 23 & Hills-Miller Road - Additional information Delaware's Request
Attachments: Chapter 8 Traffic Impact Study.pdf

Tim,

Please see comments below from the City of Delaware. They are requesting some additional information. I assume we will work on this as well as Miami Twp SR 741 next week.

Christine Hilbert
Transportation Project Manager



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8534 Yankee Street, Suite 2B, Dayton, Ohio 45458-1889
P: (937) 435-8584 Ext. 1133 | **F:** (937) 435-3307
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Email: hilbert@cesoinc.com | **Website:** www.cesoinc.com

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To: Christine Hilbert
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I have also attached our TIS standards for your reference. Please let me know if you have any questions.

Thanks,

*Jessica A. Ormeroid, PE, PTOE
Project Engineer II
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Delaware, OH 43015
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jstachler@delawareohio.net

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Sent: Monday, June 30, 2014 10:54 AM
To: Jennifer Stachler
Cc: dcarlin@dot.state.oh.us; jpiccin@co.delaware.oh.us; mlove@co.delaware.oh.us; James Leeseberg; Tim Lowe
Subject: Speedway Development US 23 & Hills-Miller Road

Jennifer,

Attached is the TIS for the subject project. If you would like hard copies or require additional information, please contact me.

Thank you for your assistance in this project.

Christine Hilbert
Transportation Project Manager



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Chapter 8: Traffic Impact Study (TIS) Standards

1. Purpose

The primary objectives of TIS are the following:

- A. Provide a basis for assessing the transportation impacts of a new development or expansion of an existing development and the need for any improvements to the adjacent road system to provide satisfactory levels of service and address safety issues.
- B. Address relevant transportation issues associated with development proposals that may be of concern to neighboring residents, businesses, and property owners.
- C. Determine the appropriate location, spacing, and design of the access system for the proposed development in compliance with City standards and sound engineering judgment.
- D. Evaluate the internal circulation and connectivity of the proposed development to provide safe and efficient internal traffic flow and access(es) to and from the adjacent and nearby roadway system.
- E. Ensure compliance with the most current edition of the City of Delaware Transportation Plan.
- F. Provide a basis for improvement and funding discussions in conjunction with zoning, special permit, and subdivision plat approvals

2. Traffic Impact Study Warrants

A traffic impact study shall be submitted when a new development or expansion of an existing development generates greater than 100 trip ends during the peak hour of the land use or the peak hour of the roadway. These trip ends are to be calculated using the latest Institute of Traffic Engineers (ITE) trip generation methodology and definitions. If the proposed development is to be implemented in phases, each major phase along with the total development trips shall be calculated for warrant purposes. The table below serves as a guideline to determine the minimum size of typical developments which would require a traffic impact study.

Table 1 Guidelines for the Minimum Size of Typical Land Uses
Requiring a Traffic Impact Study*

| ITE Land Use Code | Land Use | Size |
|-------------------|---|---------------|
| 210 | Single Family Homes | 100 DU |
| 220 | Apartments | 150 DU |
| 230 | Residential Condominiums/Townhomes | 200 DU |
| 710 | General Office | 50,000 sf gfa |
| 820 | Shopping Center | all |
| 832 | High Turnover, Sit Down Restaurant | all |
| 834 | Fast Food Restaurant with Drive-Thru Window | all |
| 845 | Service Station with Convenience Market | all |
| 850 | Supermarket | all |

* Actual requirement is based on trip ends greater than 100 during the peak hour of the land use or the roadway.

Traffic impact studies may also be required for the following situations unless in the opinion of a qualified traffic engineer, the development will generate less than 100 trips in the peak hour of the land use or the peak hour of the roadway:

- A. All developments which are not addressed in the latest ITE Trip Generation Report
- B. Mixed use developments
- C. Proposed development and redevelopment at locations where the existing roadway network already functions at an unacceptable level of service.

The City of Delaware retains the right to request a TIS or other traffic study for a non-major development (less than 100 trip ends during the peak hour of the land use or roadway). Such a request shall be made within 30 days of the receipt by the City of the developer's application for rezoning, zoning variance, special permit, or preliminary subdivision plat.

The City shall be consulted to determine if a revised or new traffic impact study is required where development plans change significantly between the time that one rezoning, zoning variance, special permit, or preliminary subdivision plat approval is granted and another is sought.

3. TIS Preparer Qualifications

Engineers with specific training in traffic and transportation engineering shall prepare traffic impact studies under the supervision of a professional engineer registered in the State of Ohio. The registered professional engineer shall have experience in traffic engineering and shall sign and seal the report.

4. Methodology Meeting

Prior to commencing the TIS, the preparer shall schedule a meeting with appropriate city staff. Other participants in this pre-meeting may be Delaware County or ODOT staff, where deemed appropriate by City of Delaware personnel. The participants at the pre-meeting shall identify and agree upon the following issues and needs prior to the preparation of the traffic impact study:

- A. Study Area
- B. Opening and Design Year
- C. Field data collection requirements
- D. Acceptable volume, accident, signal and other traffic data
- E. Development phasing, if applicable
- F. Peak traffic hours (analysis hours)
- G. Trip generation, trip distribution and assignment methods
- H. Applicable planning documents
- I. Other traffic impact studies prepared for developments in the study area
- J. Utilization of MORPC Regional Transportation Model
- K. Background traffic and growth factors
- L. Acceptable Level-of-Service (LOS)
- M. Analyses – i.e., capacity, signal warrant
- N. Safety issues – i.e., sight distance and accident data
- O. Existing geometrical issues
- P. Committed and planned roadway improvements and schedule

- Q. Existing Environmental issues that could affect roadway alignment
- R. TIS submittal date

The preparer shall submit a Memorandum of Understanding (MOU) which details the assumptions and methodologies agreed upon in the pre-meeting and request City staff concurrence with its contents. The MOU shall be submitted to the City within one week after the meeting and shall be approved within one additional week.

5. Requirements

- A. Study Area: The minimum geographical area to be analyzed in the TIS shall be defined as an area which includes all site access drives and the major roadway intersections nearest to the subject development site. The City of Delaware retains the right to modify the minimum study area based on local or site-specific issues or development size. Any changes shall be clearly defined at the pre-meeting and in the MOU.
- B. Access Management: Unless otherwise justified, the recommendations made in the TIS shall comply with the standards and specifications contained in the:
 - 1. ODOT State Highway Access Manual for State Highways
 - 2. Access Management Standards set forth by the City of Delaware
 - 3. The City of Delaware South East Area Transportation Improvement Plan
 - 4. The City of Delaware South West Access Management Plan (Industrial Park)
 - 5. The Delaware County Thoroughfare Plan
 - 6. The ODOT District 6 Delaware US 23 Access Management Plan
 - 7. And any related, applicable transportation plans
- C. Design Year

Table 8-2: Vehicle Trips vs. TIS Design Year

| Vehicle Trip Ends in the Peak Hour of the Proposed Development | TIS Design Year |
|--|---|
| 100 but less than 400 | 10 years from the planned build-out of the development |
| 400 or greater | 20 years from the planned build-out of the development |

Note: The planned build-out date is to be used as the default condition. Opening day may be used at the discretion of the City on a case-by-case basis.

- D. Existing Conditions: The TIS shall examine existing conditions using Synchro™ software and level-of-service (LOS) using traffic count data less than one year old unless otherwise agreed upon during the pre-meeting.

- E. No Build/Build: The TIS shall examine “before and after”, or No Build and Build, conditions in order to evaluate traffic impacts associated with the proposed development. No Build and Build conditions shall be calculated for the opening year and for the design year using the latest version of Synchro® Software from Trafficware® Ltd., based on the procedures of the most recent version of the *Highway Capacity Manual, TRB Special Report #209*. If the proposed development is to be implemented in phases, each major phase shall be analyzed and the conditions noted in the MOU.
- F. Analysis Time Period - All analyses shall examine the weekday peak traffic hours of the adjacent roadway. However, land use classifications which experience their highest trip generation levels during periods other than weekday street peak hours shall require analyses of off peak conditions to determine proper site access and turn lane storage requirements. Examples of such land uses include but are not limited to shopping centers, discount stores, recreational uses, and special events. The peak traffic hours to be analyzed shall be decided at the pre-meeting and be clearly stated in the MOU.
- G. Site Traffic - Trips generated by the proposed site development shall be calculated using the most current edition of the Institute of Transportation Engineers (ITE) *Trip Generation* manual and the methodologies contained therein including those relating to pass-by, internal and diverted trips. The engineer is cautioned not to automatically assume the least value assigned to any specific trip generation category.

Distribution and assignment of the site traffic shall be based on the method agreed upon at the pre-meeting and on engineering judgment and take into account the following:

1. Type of proposed development and the area from which it will attract traffic
2. Size of the proposed development
3. Surrounding land uses, employment centers, residential centers and population during both opening and design years
4. Conditions on the surrounding street system
5. Logical routings
6. Projected roadway capacities
7. Travel times

- H. Non-site Traffic - All significant developments within the study area that have approved or TIS studies should be identified and incorporated into the study. The land use type and magnitude of probable future developments should be identified during the pre-meeting and enumerated in the MOU. The method of projecting non-site traffic shall depend upon the area of study. Use of the traffic volumes from the transportation model, historic growth rates, or the buildup method shall be agreed upon during the pre-meeting and documented in the MOU.
- I. Level-of-Service (LOS) Criteria: It is the goal of the City of Delaware to maintain a LOS C or better for the 24-hour period and LOS D or better during peak traffic hours for the operation of all roadways. In any area where the current level of service is C or worse for a 24-hour period or D or worse during peak traffic hours, this baseline level of service must be maintained or improved after development.
- J. Mitigation: Recommendations shall be made in the TIS for site access points, external roadway improvements such as additional through lanes and turn lanes, and traffic

control devices necessitated as a result of the proposed development. The developer will be required to mitigate the impacts of traffic generated by the project. The time period for the recommended improvements shall be identified, particularly if improvements are associated with various phases of the development. Identified improvements to the roadway system, unrelated to the proposed development, shall also be reported.

- K. Traffic Signal Warrant: Traffic signal warrant analyses shall be conducted at unsignalized intersections in the study area for Opening Day and the Design Year and at all multi-movement access points to the proposed development. A full signal warrant analysis and an estimation of the year the warrant is met shall be done if the main site access appears to meet Traffic Signal Warrant 1 or Warrant 2 based on the guidelines in Table 11. Any proposed access or intersection which meets signal warrant thresholds but does not otherwise meet the spacing requirements and standards noted in the ODOT *State Highway Access Management Manual* for the access category assigned by the City of Delaware Transportation Plan may be required to be redesigned, reconstructed, and/or relocated.

Table 8-3: Signal Warrants

| WARRANT 1 – Minimum Vehicular Volume* | | | |
|---|-------|--------|-------|
| NUMBER OF APPROACH LANES | | ADT | |
| MAJOR | MINOR | MINOR | MAJOR |
| 1 | 1 | 8,300 | 5,000 |
| 2 | 1 | 10,000 | 5,000 |
| 2 | 2 | 10,000 | 6,700 |
| 1 | 2 | 8,300 | 6,700 |
| WARRANT 1 – Interruption of Continuous Traffic* | | | |
| NUMBER OF APPROACH LANES | | ADT | |
| MAJOR | MINOR | MINOR | MAJOR |
| 1 | 1 | 12,500 | 2,500 |
| 2 | 1 | 15,000 | 2,500 |
| 2 | 2 | 15,000 | 3,000 |
| 1 | 2 | 12,500 | 3,000 |

* When the 85th percentile speed of major street traffic exceeds 40 mph in either an urban or rural area, or when the intersection lies within the built up area of an isolated community having a population of less than 10,000, the warrants are 70 percent of the guidelines above.

Warrants 3 through 8 may be required to be analyzed on a case-by-case basis at the discretion of the City. If a signal is warranted it may not be permitted if it conflicts with the City of Delaware Transportation Plan.

The City reserves the right to require access limitations to offset the warrant if adequate signal spacing cannot be accomplished. Conversely, the City may approve a signal where it is technically not warranted if it is in the public’s best interest, is needed from a practical standpoint, and is justified by sound engineering judgment.

L. Turn Lane Criteria

1. A left turn lane at driveways or unsignalized movements at intersections should be provided under the following conditions:
 - a. Per Graph 1, 2, or 3, which are the left turn lane warrant charts contained in the ODOT Location and Design Manual, Volume I.
 - b. On major and minor arterial roadways with posted speed limits greater than 40 mph
 - c. On major collector roadways with posted speed limits greater than 40 mph and more than 10 left turning vehicles during the peak hour for full build out of the development
 - d. The size of left turn lanes shall be the minimum per based on the criteria contained in this Manual and/or the ODOT Location and Design Manual, Volume I, Section 400.

2. Right turn lanes should be provided:
 - a. Per Graphs 4, 5, 6 or 7, which are the right turn lane warrant charts contained in the ODOT State Highway Access Management Manual
 - b. Are not required for right turn volumes less than 10 vehicles during the peak hour for full build out of the development
 - c. Are not required for less than 200 vehicles in the peak hour in the approach lane or curb lane for roadways with greater than 1 approach lane for full build out of the development.

Left or right turn lanes shall also be required when deemed necessary for safety as determined by the City of Delaware.

6. Report Contents: Each TIS shall have, along with the body of the report, the following unless a letter report is agreed upon at the pre-meeting:
 - A. Cover: Noting the name and location of the development, the applicant's name, preparer's name, and report date.
 - B. Title Page: Containing all information on the cover in addition to the applicant's street and email address, telephone and fax numbers; the preparer's street and email address, telephone and fax numbers and the preparer's signature and seal.
 - C. Table of Contents
 - D. List of Exhibits and Tables
 - E. Executive Summary
 - F. Summary of Revisions (for revised reports)
 - G. Body of Report
 - H. Proposed Site Development
 - I. Area Conditions
 - J. Existing Traffic
 - K. Trip Generation and Distribution
 - L. Site Traffic
 - M. Total Traffic – Opening Year and Design Year

- N. Traffic Analyses
- O. Capacity Analyses
- P. Signal Warrant Analyses
- Q. Turn Lane Warrant Analyses
- R. Sight Distance
- S. Accident Analyses
- T. Conclusions
- U. Recommendations – including the identification of responsibility for all recommended improvements
- V. Appendix: The following figures and tables shall be included in the body of the report:
The following illustrations or tables shall be included in the body of the report:
 - 1. Location Map
 - 2. Site Layout Map
 - 3. Site Trip Generation Factors and Volumes Table
 - 4. Site Traffic Distribution by Percent Map
 - 5. Existing Traffic Volumes Map
 - 6. Opening Year Traffic Volumes Map – use $A + B + C + D = \text{Total}$ diagram where A is opening year background traffic, B is other site traffic (if applicable), C is site pass by traffic, D is site traffic
 - 7. Design Year Traffic Volumes Map – use $A + B + C + D = \text{Total}$ diagram where A is design year background traffic, B is other site traffic (if applicable), C is site pass by traffic, D is site traffic
 - 8. Existing and Projected LOS Table
 - 9. Preliminary Site Plan Map - showing recommended improvements, both sides of streets and extending 1000 feet beyond the site.

7. Submittal

Two copies of the TIS shall be submitted to the City of Delaware Department of Engineering Services at the time of filing an application for zoning or rezoning. If zoning is already in place, the TIS shall be submitted to the Assistant City Engineer – Development at the time of application for Preliminary Plat approval or at the time of application for a Preliminary Development Plan, whichever occurs first.

It is the COD's goal to review and respond within 6 – 8 weeks of the submittal date of a TIS that is formatted in an acceptable manner to the Department. Upon review, if the document is deemed inadequate, the applicant shall be notified in writing and shall have an opportunity to correct the deficiencies and resubmit the report. Upon approval, two paper copies and one digital copy (including all Synchro® files) of the final TIS shall be provided.

8. Signal Warrant Figures:

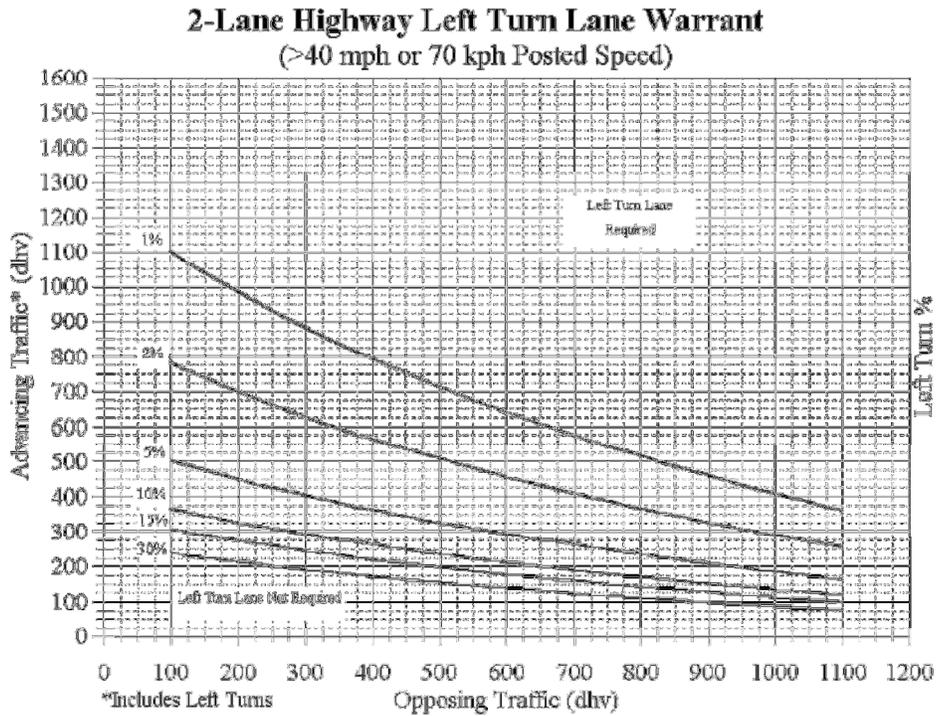


Figure 8-1: 2-Lane Highway Left Turn Warrant (> 40 mph)

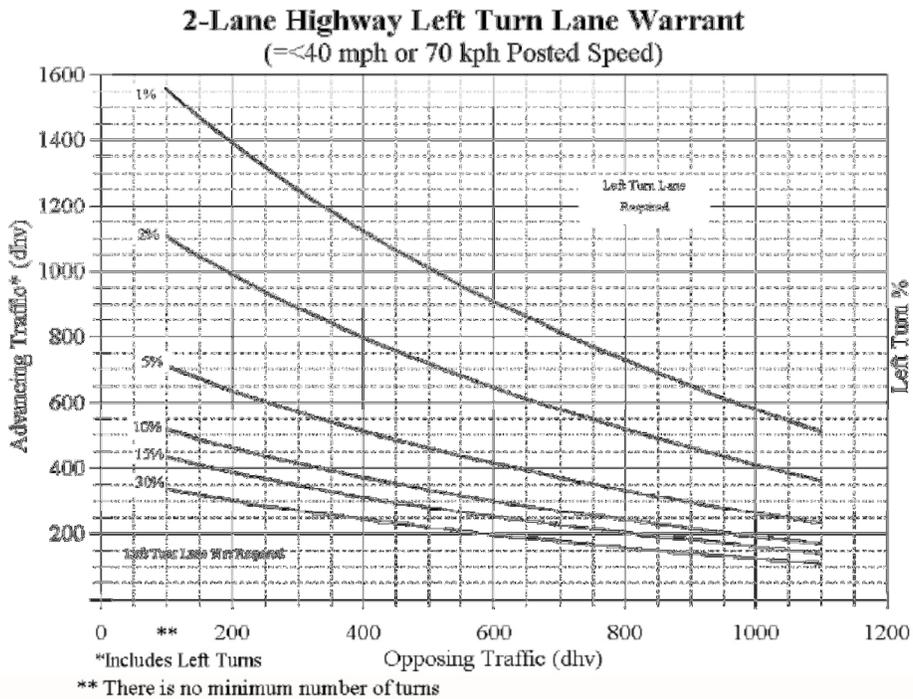


Figure 8-2: 2-Lane Highway Left Turn Warrant (< 40 mph)

4-Lane Highway Left Turn Lane Warrant

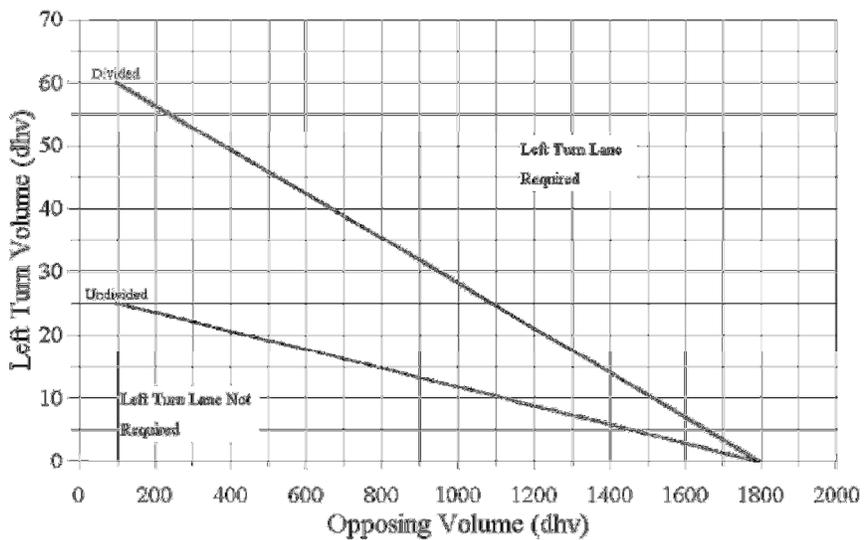


Figure 8-3: 4-Lane Highway Left Turn Warrant

4 Lane Highway Right Turn Lane Warrant (=<40 mph or 70 kph Posted Speed)

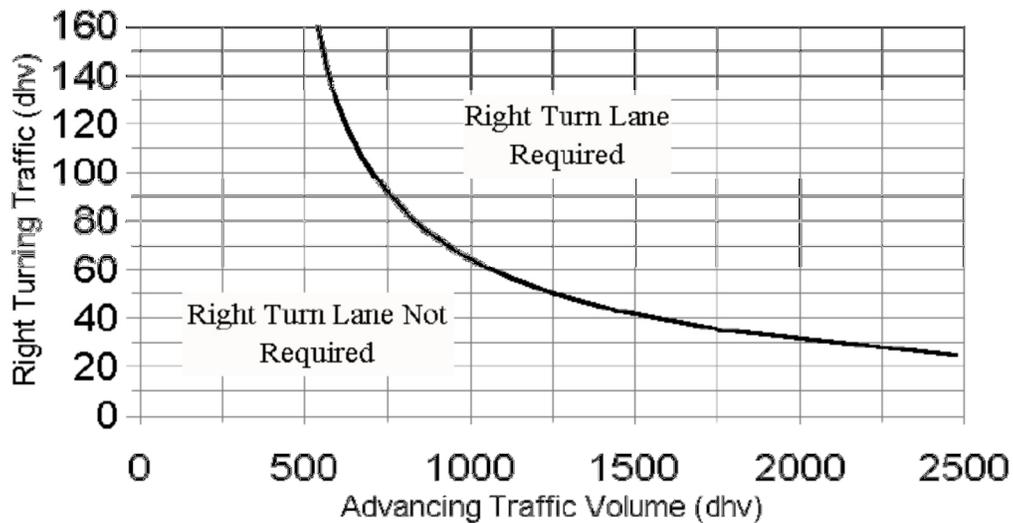


Figure 8.-4-Lane Highway Right Turn Lane Warrant (<40 mph)

4 Lane Highway Right Turn Lane Warrant
(>40 mph or 70 kph Posted Speed)

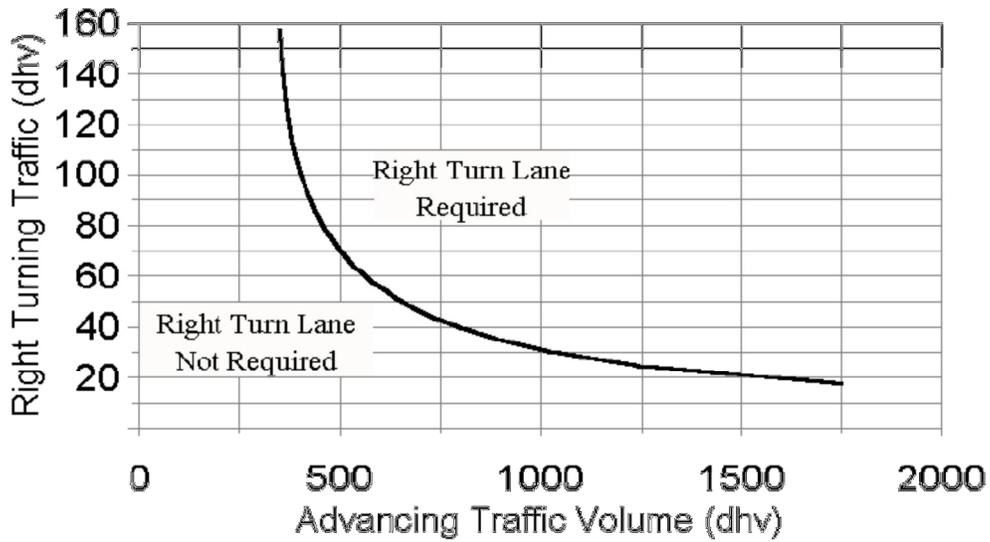


Figure 8-5: 4 Lane Highway Right Turn (>40 mph)

2-Lane Highway Right Turn Lane Warrant
> 40 mph or 70 kph Posted Speed

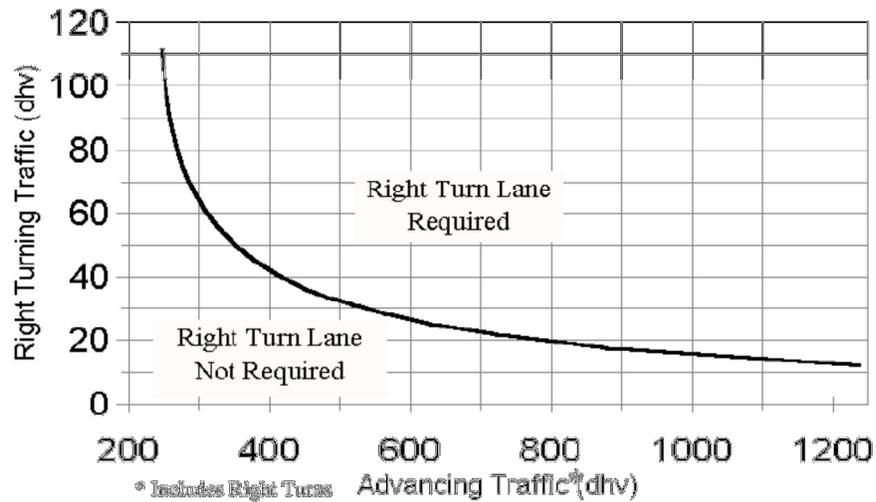


Figure 1-6: 2-Lane Highway Right Turn Warrant (> 40 mph)

2-Lane Highway Right Turn Lane Warrant
=< 40 mph or 70 kph Posted Speed

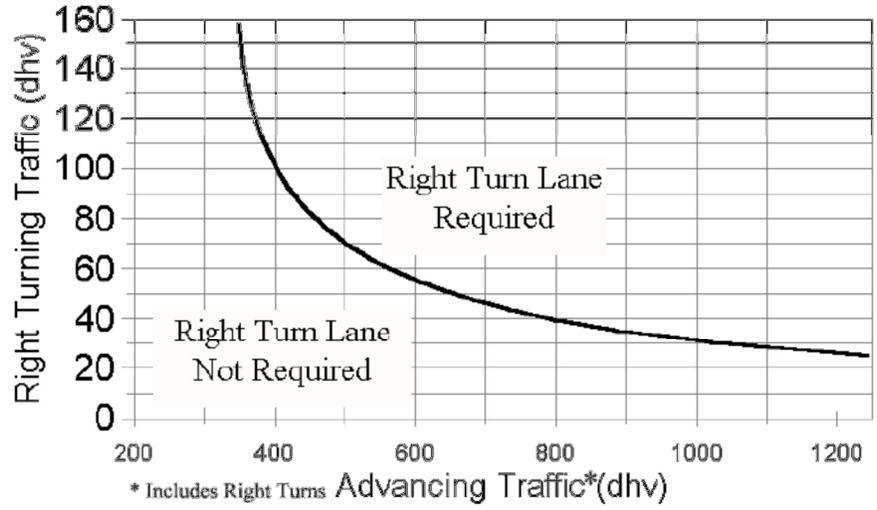


Figure 8-7: 2-Lane Highway Right Turn Warrant (< 40 mph)



8534 Yankee Street, Suite 2B
Dayton, Ohio 45458-1889
(937) 435-8584
www.cesoinc.com

MEMORANDUM OF UNDERSTANDING

TO: Jennifer Stachler, P.E. – Land Development Public Works Department City of Delaware

CC: Nick Hershberger, P.E. – CESO, Inc.
Robert Matko, P.E., P.S., P.T.O.E. – CESO, Inc.

FROM: Christine Hilbert, Project Manager
Timothy Lowe, P.E.

DATE: June 18, 2014

SUBJECT: MOU for Traffic Impact Study associated with Speedway #100359 – Delaware, OH

CESO #: 750421

A traffic impact study (TIS) is required for the Proposed Speedway fueling station and convenience store on U.S. 23 and Hills-Miller Road in Delaware, Ohio. The study will be based on guidelines established in the Institute of Transportation Engineers (ITE) 9th Edition, Traffic Access and Impact Studies for Site Development and the ODOT State Highway Access Management Manual.

The following requirements are proposed to maintain consistency with current guidelines and standards. The MOU is based on discussions with Speedway and the City of Delaware.

1. Study Area

The study area consists of the intersection of U.S. 23 and Hills Miller Road as well as the proposed driveway locations for the Speedway development. The proposed study area is shown in **Figure 1**.

2. Opening and Design Year

2015 will be used for the Opening Year and 2035 for the Design Year.

3. Field Data Collection

CESO performed two-hour manual counts for the AM and PM weekday peak periods on Tuesday June 3, 2014 and twenty-four hour counts will be performed Tuesday June 17 through Wednesday June 18, 2014 at the U.S. 23/Hills-Miller Road intersection.

4. Additional Data Collection

- Existing signal timing at U.S. 23 and Hills-Miller Road has been obtained from the City in order to properly analyze the capacity of the intersection in the background and build conditions for the proposed development. Currently the signal operates as “free running”; 80 or 90 seconds will be used for the cycle length in the analysis.
- Accident data will be requested Ohio Department of Public Safety (ODPS) for evaluation and discussion in the Traffic Study.

5. **Phased Analysis**

The proposed development will not be phased.

6. **Peak Traffic Hours**

Peak traffic hours typically occur between the hours of 7-9 AM and 4-6 PM on roadway networks. There do not appear to be any land uses in the vicinity that would indicate differently. Due to the "pass-by" nature of fueling stations and convenience stores, the peak hours for the proposed development will coincide with the surrounding roadway network.

7. **Trip Generation**

The trip rates for the proposed site will be based on the ITE Trip Generation manual, latest edition for a Service Station with Convenience Market (LU Code 945). The proposed site includes seventeen (17) fueling positions as shown in Figure 2. A summary of the proposed trip generation is included in Table 1.

Table 1: Trip Generation Summary

| Land Use Code | Land Use Description | Qty | Unit | AM Peak | PM Peak |
|---------------|---|-----|---------------------------|------------|------------|
| 945 | Service Station with Convenience Market | 17 | Vehicle fueling Positions | 173 | 229 |
| Total | | | | 173 | 229 |

Average pass-by rates for LU Code 945 in the ITE Trip Generation Manual will be used and are listed as 62% during the AM peak hours and 56% during the PM peak hours. Table 2 summarizes entering, exiting, and pass-by vehicle trips for the proposed site.

Table 2: Trip End Summary

| ITE TRIP GENERATION | | UNIT | TRIP ENDS | | | | | |
|---------------------|---|----------------------------|------------|----|----------------------------|------------|----|-----|
| ITE Code | Description | | Weekday | | | | | |
| | | A.M. Peak (In/Out/Pass-by) | | | P.M. Peak (In/Out/Pass-by) | | | |
| 945 | Service Station with Convenience Market | 17 Fueling Positions | 33 | 33 | 107 | 50 | 50 | 129 |
| Totals | | | 173 | | | 229 | | |

Table 3: Trip Distribution

| Route | Approach/Departure Primary Trip Distribution | |
|----------------------------------|--|------------------|
| | AM Peak | PM Peak |
| To/From US 23 Northbound | 35%/50% | 50%/35% |
| To/From US 23 Southbound | 50%/35% | 35%/50% |
| To/From Hills Miller Road (West) | 15%/15% | 15%/15% |
| Total | 100%/100% | 100%/100% |

8. Applicable Planning Documents

No applicable planning documents were available in this area. The directional distribution of project traffic was based on the existing traffic volumes and population distribution in the area.

9. Other Traffic Impact Studies within Study Area

There are no other current TIS in this area. Based on the traffic distribution, the development-generated traffic volumes will be assigned to the adjacent street network.

10. Utilization of MORPC Regional Transportation Model

Existing traffic count data available through MORPC in the study area dates back to 1995. As a result, updated data will be used for the project.

11. Background Traffic and Growth Factors

Background traffic in the design year will be based upon the traffic data collected as part of the study extrapolated to the design year through the use of a 1% growth rate.

12. Acceptable Level-of-Service (LOS)

Capacity analysis for future BUILD conditions shall not degrade the operations of the existing intersections below a LOS D during the peak traffic hours. In areas where LOS is worse than D during the peak traffic hours, the baseline LOS must be maintained. The capacity analysis will not include the addition of through lanes on U.S. 23 as directed at the Methodology Meeting.

13. Analysis

Capacity

Intersection analysis will include capacity analysis for the AM and PM peak hours during a typical weekday. Four (4) conditions will have capacity analysis performed to properly assess impacts to the development:

- 2015 Background Traffic Scenario
- 2015 Build Traffic Scenario
- 2035 Background Traffic Scenario
- 2035 Build Traffic Scenario

Capacity analysis shall include the following basic parameters not to be changed:

- The capacity analysis output shall use Synchro 8 - HCM 2010 algorithms to calculate Level of Service (LOS).

Warrants

There is an existing signal at U.S. 23 and Hills Miller Road so a signal warrant analysis will not be necessary. Due to the volumes entering and exiting the proposed Speedway development, a signal warrant analysis for the site driveways will not be required.

A turn lane warrant analysis will be completed for a southbound right turn lane from U.S. 23 into the proposed right-in/right-out site driveway, and a westbound right turn lane and an eastbound left turn lane from Hills-Miller Road into the proposed site driveway. The TIS will analyze the existing turn lane storage lengths on all approaches at the U.S. 23/Hills-Miller Road intersection. Criteria for the turn lane warrants will be as required in the City of Delaware TIS Guidelines. Any warranted turn lane storage lengths will be determined using ODOT's *Location and Design Manual, Volume 1*.

14. Safety Issues

Based upon preliminary site evaluations, it does not appear that there are sight distance problems or reason to believe that safety concerns exist within the Study Area. Accident reports will be collected from ODPS to determine if any unforeseen safety concerns exist.

15. Existing Geometrical Issues

- As requested at the Methodology Meeting, the lane widths on U.S. 23 at the south side of the U.S. 23/Hills-Miller Road intersection will be obtained. A drawing will be provided that shows the lane widths at this location.
- On the site plan, relocate the site driveway approximately 30'-40' to the east as it intersects Hills-Miller Road.
- Change circulation of the site so that exiting semi-tractor trailers wishing to go southbound can use the right-in/right-out access on U.S. 23.

16. Committed and Planned Roadway Improvements and Schedule

A signal head and wiring replacement project is planned and may occur prior to the development's Opening Day. Signal poles and controller are not being upgraded as part of this planned project.

17. Existing Environmental issues that could affect roadway alignment

There are no known existing environmental issues that could affect roadway alignment.

18. TIS Submittal Date

It is anticipated that the initial draft of the TIS will be submitted by June 30, 2014.



8534 Yankee Street, Suite 2B
Dayton, Ohio 45458-1889
(937) 435-8584
www.cesoinc.com

MEMORANDUM OF UNDERSTANDING

TO: Jennifer Stachler, P.E. – Land Development Public Works Department City of Delaware

CC: Nick Hershberger, P.E. – CESO, Inc.
Robert Matko, P.E., P.S., P.T.O.E. – CESO, Inc.

FROM: Christine Hilbert, Project Manager
Timothy Lowe, P.E.

DATE: June 12, 2014

SUBJECT: **MOU for Traffic Impact Study associated with Speedway #100359 – Delaware, OH**

CESO #: 750421

A traffic impact study (TIS) is required for the Proposed Speedway fueling station and convenience store on U.S. 23 and Hills-Miller Road in Delaware, Ohio. The study will be based on guidelines established in the Institute of Transportation Engineers (ITE) 9th Edition, Traffic Access and Impact Studies for Site Development and the ODOT State Highway Access Management Manual.

The following requirements are proposed to maintain consistency with current guidelines and standards. The MOU is based on discussions with Speedway and the City of Delaware.

1. Study Area

The study area consists of the intersection of U.S. 23 and Hills Miller Road as well as the proposed driveway locations for the Speedway development. The proposed study area is shown in **Figure 1**.

2. Opening and Design Year

2015 will be used for the Opening Year and 2035 for the Design Year.

3. Field Data Collection

CESO performed two-hour manual counts for the AM and PM weekday peak periods on Tuesday June 3, 2014 and twenty-four hour counts will be performed Tuesday June 17 through Wednesday June 18, 2014 at the U.S. 23/Hills-Miller Road intersection.

4. Additional Data Collection

- Existing signal timing at U.S. 23 and Hills-Miller Road has been obtained from the City in order to properly analyze the capacity of the intersection in the background and build conditions for the proposed development. Currently the signal operates as “free running”; 80 or 90 seconds will be used for the cycle length in the analysis.
- Accident data will be requested Ohio Department of Public Safety (ODPS) for evaluation and discussion in the Traffic Study.

5. Phased Analysis

The proposed development will not be phased.

6. Peak Traffic Hours

Peak traffic hours typically occur between the hours of 7-9 AM and 4-6 PM on roadway networks. There do not appear to be any land uses in the vicinity that would indicate differently. Due to the "pass-by" nature of fueling stations and convenience stores, the peak hours for the proposed development will coincide with the surrounding roadway network.

7. Trip Generation

The trip rates for the proposed site will be based on the ITE Trip Generation manual, latest edition for a Service Station with Convenience Market (LU Code 945). The proposed site includes seventeen (17) fueling positions as shown in **Figure 2**. A summary of the proposed trip generation is included in **Table 1**.

Table 1: Trip Generation Summary

| Land Use Code | Land Use Description | Qty | Unit | AM Peak | PM Peak |
|---------------|---|-----|---------------------------|------------|------------|
| 945 | Service Station with Convenience Market | 17 | Vehicle fueling Positions | 173 | 229 |
| Total | | | | 173 | 229 |

Average pass-by rates for LU Code 945 in the ITE Trip Generation Manual will be used and are listed as 62% during the AM peak hours and 56% during the PM peak hours. **Table 2** summarizes entering, exiting, and pass-by vehicle trips for the proposed site.

Table 2: Trip End Summary

| ITE TRIP GENERATION | | UNIT | TRIP ENDS | | | | | |
|---------------------|---|----------------------------|------------|----|----------------------------|------------|----|-----|
| ITE Code | Description | | Weekday | | | | | |
| | | A.M. Peak (In/Out/Pass-by) | | | P.M. Peak (In/Out/Pass-by) | | | |
| 945 | Service Station with Convenience Market | 17 Fueling Positions | 33 | 33 | 107 | 50 | 50 | 129 |
| Totals | | | 173 | | | 229 | | |

Table 3: Trip Distribution

| Route | Approach/Departure Primary Trip Distribution | |
|----------------------------------|--|------------------|
| | AM Peak | PM Peak |
| To/From US 23 Northbound | 35%/50% | 50%/35% |
| To/From US 23 Southbound | 50%/35% | 40%/50% |
| To/From Hills Miller Road (West) | 15%/15% | 15%/15% |
| Total | 100%/100% | 100%/100% |

35 or 40?
15 or 10?

8. Applicable Planning Documents

No applicable planning documents were available in this area. The directional distribution of project traffic was based on the existing traffic volumes and population distribution in the area.

9. Other Traffic Impact Studies within Study Area

There are no other current TIS in this area. Based on the traffic distribution, the development-generated traffic volumes will be assigned to the adjacent street network.

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Existing traffic count data available through MORPC in the study area dates back to 1995. As a result, updated data will be used for the project.

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Background traffic in the design year will be based upon the traffic data collected as part of the study extrapolated to the design year through the use of a 1% growth rate.

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Capacity analysis for future BUILD conditions shall not degrade the operations of the existing intersections below a LOS D during the peak traffic hours. In areas where LOS is worse than D during the peak traffic hours, the baseline LOS must be maintained. The capacity analysis will not include ~~the through movements on U.S. 23~~ as directed at the Methodology Meeting.

the addition of through lanes on US23 ?

13. Analysis

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- 2015 Background Traffic Scenario
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Warrants

There is an existing signal at U.S. 23 and Hills Miller Road so a signal warrant analysis will not be necessary. Due to the volumes entering and exiting the proposed Speedway development, a signal warrant analysis for the site driveways will not be required.

A turn lane warrant analysis will be completed for a southbound right turn lane from U.S. 23 into the proposed right-in/right-out site driveway, and a westbound right turn lane and an eastbound left turn lane from Hills-Miller Road into the proposed site driveway. Criteria for the turn lane warrants will be as required in the City of Delaware TIS Guidelines. Any warranted turn lane storage lengths will be determined using ODOT's *Location and Design Manual, Volume 1*.

Look at ~~turn~~ existing turn lane storage on all approaches of US23-HillsMiller Rd.

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Based upon preliminary site evaluations, it does not appear that there are sight distance problems or reason to believe that safety concerns exist within the Study Area. Accident reports will be collected from ODPS to determine if any unforeseen safety concerns exist.

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- Change circulation of the site so that exiting semi-tractor trailers wishing to go southbound use the right-in/right-out access on U.S. 23. *can?*

16. Committed and Planned Roadway Improvements and Schedule

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A signal head and wiring replacement

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16. Committed and Planned Roadway Improvements and Schedule

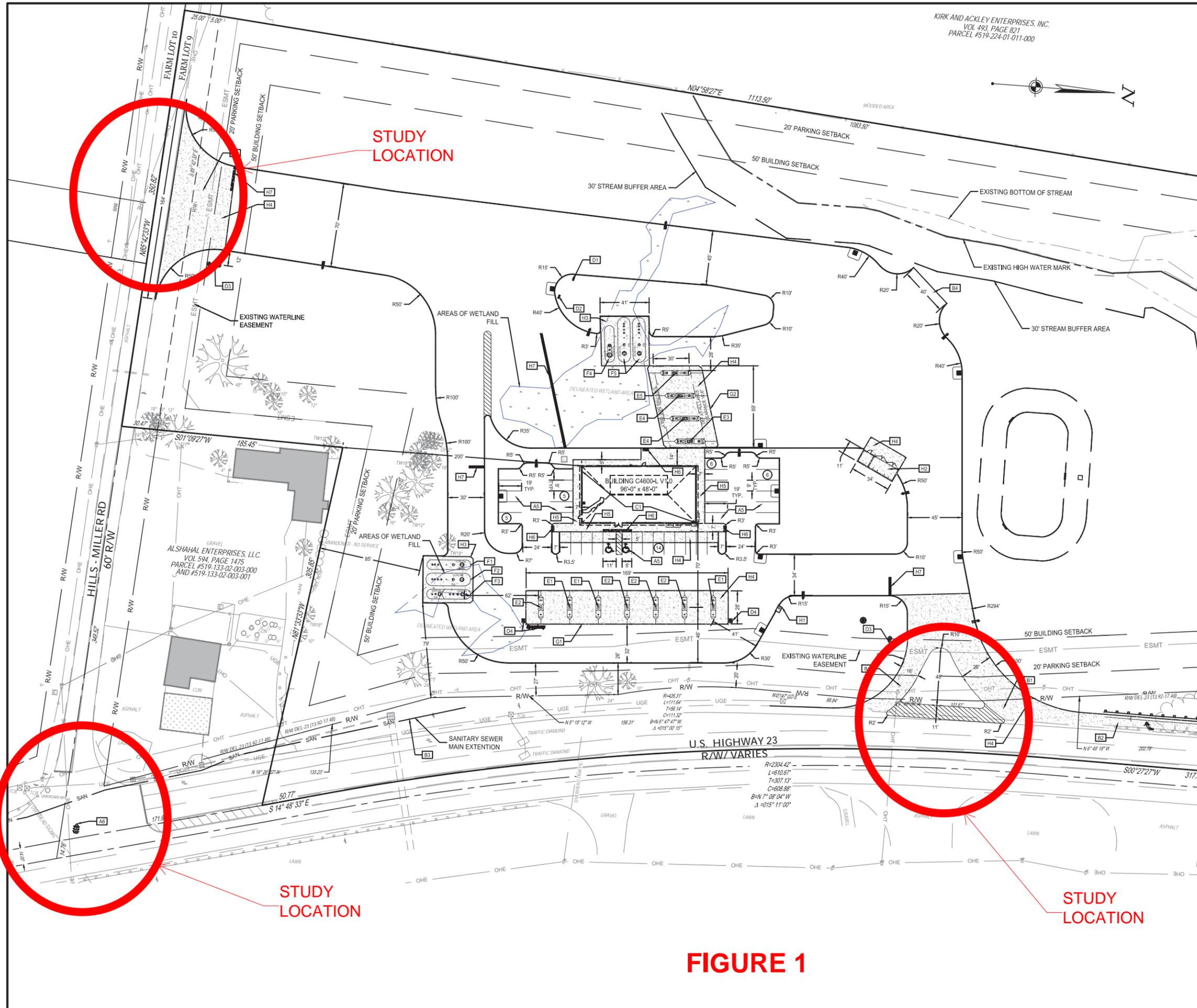
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KIRK AND ACKLEY ENTERPRISES, INC.
VOL 493, PAGE 821
PARCEL #519-224-01-011-000

ALSHAHAL ENTERPRISES, LLC.
VOL 594, PAGE 1475
PARCEL #519-133-02-003-000
AND #519-133-02-003-001

U.S. HIGHWAY 23
R/W VARIES

FIGURE 1

- A. GENERAL NOTES**
- GENERAL SCOPE OF WORK INCLUDES: BUILDING, CANOPY, FUEL TANKS, PIPING AND DISPENSERS AND PARKING.
 - TRUCK TURNS HAVE BEEN PERFORMED ON THIS SITE TO CONFIRM LOCATION OF UST'S.
 - FINAL DESIGN OF SITE SUBJECT TO LOCAL AND STATE REGULATIONS.
 - EXISTING PROPERTY SIZE: 498,806 SQ. FT. / 11.45 AC.
 - PROVIDED PARKING: (2) ADA PARKING SPACES AND (34) STANDARD PARKING SPACES.
 - THE ADJACENT INTERSECTION OF HILLS-MILLER ROAD AND US HIGHWAY 23 IS SIGNALIZED.
- B. SITE WORK**
- PROPOSED DRIVE APPROACH.
 - RIGHT TURN LANE.
 - EXTEND SANITARY SEWER MAIN.
 - FUTURE CROSS ACCESS.
- C. BUILDING**
- STANDARD #600-L V10.0 BUILDING WITH OPTIONAL ALUCOBOND SCREENING.
- D. EXTERIOR APPEARANCE & SIGNAGE**
- "TRUCK ENTRANCE ONLY" SIGN.
 - "TRUCK EXIT ONLY" SIGN.
 - (2) NEW 15' HIGH 100 SQ. FT. (MAX) MONUMENT SIGNS WITH MASONRY BASES.
 - CANOPY SIGNAGE.
- E. DISPENSERS**
- (3) 3+1 DISPENSERS, SUMPS, AND ISLANDS.
 - (4) 3+0 DISPENSERS, SUMPS, AND ISLANDS.
 - INSTALL (1) NEW MASTER DIESEL DISPENSER, SUMP, AND ISLAND.
 - INSTALL (2) NEW MASTER / SATELLITE DIESEL DISPENSERS, SUMPS, AND ISLANDS.
 - INSTALL (1) NEW SATELLITE DIESEL DISPENSER, SUMP, AND ISLAND.
- F. UNDERGROUND STORAGE TANKS**
- (1) 12,000 GALLON TANK FOR DIESEL.
 - (1) 20,000 GALLON TANK FOR UNLEADED.
 - (1) 12,000 GALLON TANK FOR PREMIUM & E85.
 - (1) 10,000 GALLON TANK FOR DIESEL EXHAUST FLUID.
 - (2) 20,000 GALLON TANK FOR DIESEL.
- G. CANOPY**
- 28' x 169' CAR ISLAND CANOPY PER CURRENT STANDARDS.
 - 30' x 69' TRUCK CANOPY PER CURRENT STANDARDS.
- H. YARD**
- AIR ISLAND.
 - TRASH ENCLOSURE.
 - CONCRETE TANK SLAB.
 - CONCRETE PAVEMENT.
 - CONCRETE SIDEWALK.
 - ADA ACCESSIBLE RAMP WITH DETECTABLE WARNING SURFACE.
 - STOP BAR
- I. ZONING, VARIANCE, SETBACKS & PERMITS**
- ZONING:**
- NORTH PROPERTY: B-3 COMMUNITY BUSINESS DISTRICT
 - EAST PROPERTY: NOT ZONED / OUTSIDE CITY LIMITS
 - SOUTH PROPERTY: B-4 GENERAL BUSINESS DISTRICT / R-6 MULTI-FAMILY DISTRICT
 - WEST PROPERTY: R-6 MULTI-FAMILY DISTRICT
- SETBACKS:**
- BUILDING: 50' (FRONT), 30' (SIDE AND REAR IF AGAINST NON-RESIDENTIAL), 50' (SIDE AND REAR IF AGAINST RESIDENTIAL)
 - CANOPY: 20' (FRONT)
 - DUMPSTER: 20' (FRONT), 5' (SIDE AND REAR IF AGAINST NON-RESIDENTIAL), 20' (SIDE AND REAR IF AGAINST RESIDENTIAL)
 - SIGNS: 10' (FRONT, SIDE, AND REAR FOR FREESTANDING POLE SIGNS), 20' (FRONT, SIDE, AND REAR FOR FREESTANDING MONUMENT SIGNS)
 - TANKS: NOT SPECIFIED
 - PARKING: 20' (FRONT), 5' (SIDE AND REAR IF AGAINST NON-RESIDENTIAL), 20' (SIDE AND REAR IF AGAINST RESIDENTIAL)
- PERMITS:**
- REQUIRED FOR WORK WITHIN RIGHT-OF-WAY FOR NEW DRIVE APPROACHES

- NOTES:**
- 0.28 ± ACRES OF WETLAND ARE EXPECTED TO BE FILLED.
- CONCRETE PAVEMENT PER SPEEDWAY STANDARDS
 - EXISTING DELINEATED WETLAND AREAS



| NO. | REVISIONS | DATE | BY | CHKD |
|-----|------------------------|----------|----|------|
| 1 | ISSUED FOR PERMITTING | 05/01/14 | | |
| 2 | REVISED PER PERMITTING | 05/01/14 | | |

PLOT PLAN
NEW BUILD
2319 US HWY. 23 N
DELAWARE COUNTY
DELAWARE, OH

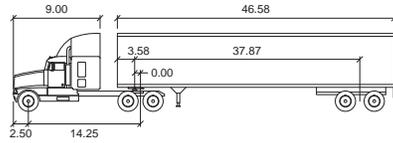
| | |
|-----------------------|-----------------|
| STORE OR BLDG NO. | 100359 |
| VERSION OR A/E NO. | 137129 |
| SCALE | 0" = 1" [SCALE] |
| GRAPHIC SCALE IN FEET | |
| DESIGN TEAM | DATE |
| DGNR. C. WARSHAW | 05/02/14 |
| P.MGR. B. WITT | 05/02/14 |
| R.WR. R. MATKO | 05/02/14 |
| DRWG. NO. | 100359-P3A |





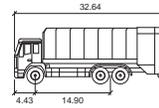
LEGEND

- 1 FT OFFSET FROM FACE OF CURB
- 5 FT OFFSET FROM FACE OF CURB
- CIRCULATION CONFLICT AREA



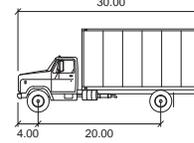
FUEL - SPEEDWAY feet

| | | | |
|---------------|--------|------------------------|--------|
| Tractor Width | : 8.00 | Lock to Lock Time | : 6.0 |
| Trailer Width | : 8.00 | Tractor Steering Angle | : 26.0 |
| Tractor Track | : 8.00 | Trailer Steering Angle | : 60.0 |
| Trailer Track | : 8.00 | | |



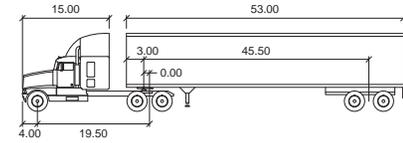
KO 2N+1 feet

| | |
|-------------------|--------|
| Width | : 8.20 |
| Track | : 6.20 |
| Lock to Lock Time | : 6.0 |
| Steering Angle | : 42.1 |



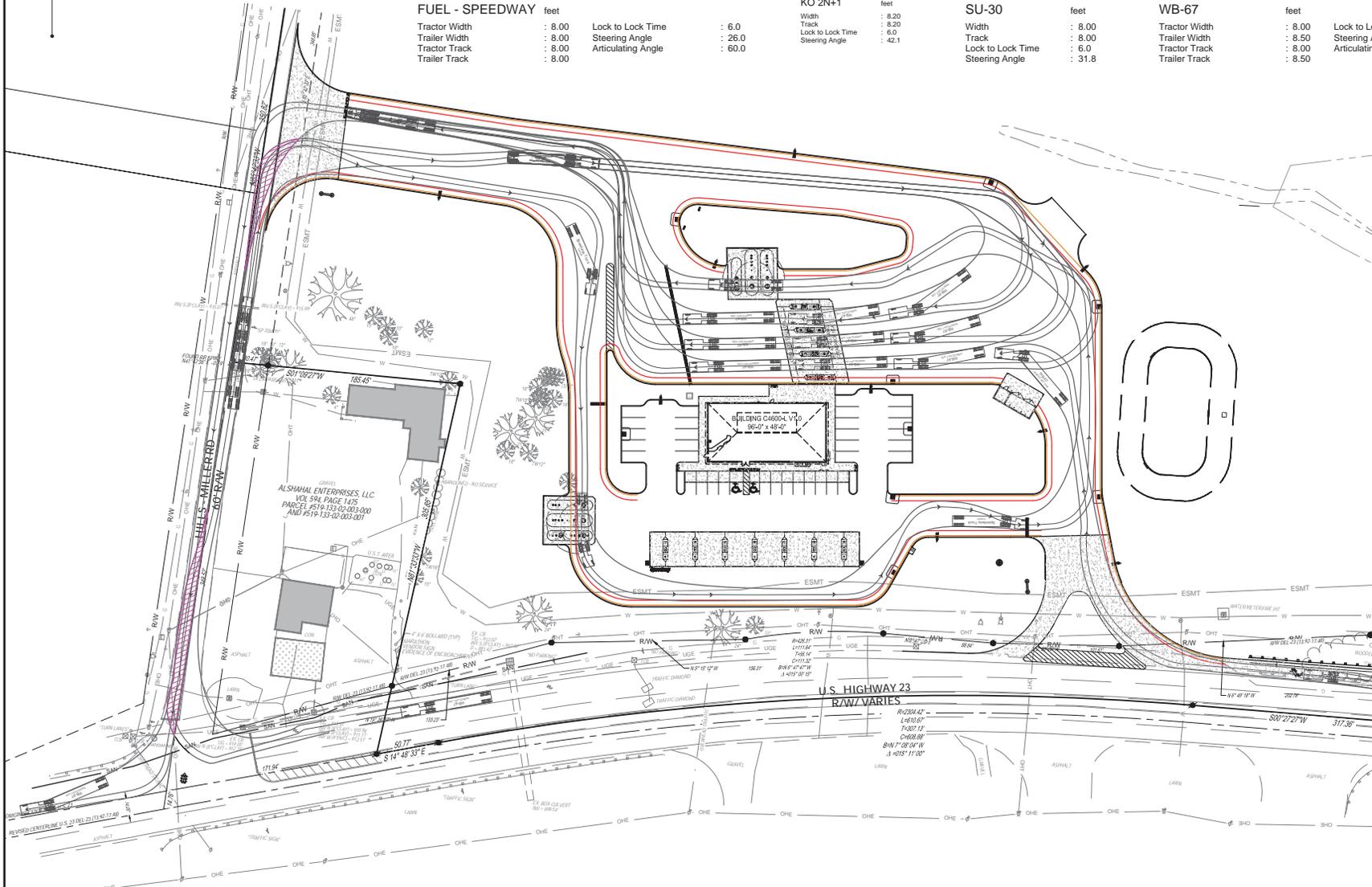
SU-30 feet

| | |
|-------------------|--------|
| Width | : 8.00 |
| Track | : 8.00 |
| Lock to Lock Time | : 6.0 |
| Steering Angle | : 31.8 |



WB-67 feet

| | | | |
|---------------|--------|------------------------|--------|
| Tractor Width | : 8.00 | Lock to Lock Time | : 6.0 |
| Trailer Width | : 8.50 | Tractor Steering Angle | : 28.4 |
| Tractor Track | : 8.00 | Trailer Steering Angle | : 75.0 |
| Trailer Track | : 8.50 | | |



ALSHAHAL ENTERPRISES, LLC
VOL 594, PAGE 1475
PARCELS #519-133-02-003-000
AND #519-133-02-003-001

U.S. HIGHWAY 23
R/W VARIES



| NO. | DATE | DESCRIPTION |
|-----|------|-------------------|
| 1 | | ISSUED FOR PERMIT |
| 2 | | ISSUED FOR PERMIT |
| 3 | | ISSUED FOR PERMIT |
| 4 | | ISSUED FOR PERMIT |
| 5 | | ISSUED FOR PERMIT |
| 6 | | ISSUED FOR PERMIT |
| 7 | | ISSUED FOR PERMIT |
| 8 | | ISSUED FOR PERMIT |
| 9 | | ISSUED FOR PERMIT |
| 10 | | ISSUED FOR PERMIT |

PRELIMINARY CIRCULATION PLAN
NEW BUILD
2319 US HWY 23 N
DELAWARE COUNTY
DELAWARE OH

| | |
|---------------|----------|
| STORER OR | 100359 |
| DESIGN OR | 137129 |
| SCALE | 1" = 40' |
| GRAPHIC SCALE | FEET |

| DESIGN TEAM | DATE |
|-------------------|----------|
| DGHL, C. WARSHPAW | 05/02/14 |
| P.MGR, B. WET | 05/02/14 |
| P.WDR, R. MARTO | 05/02/14 |

100359-P3A1

FIGURE 2