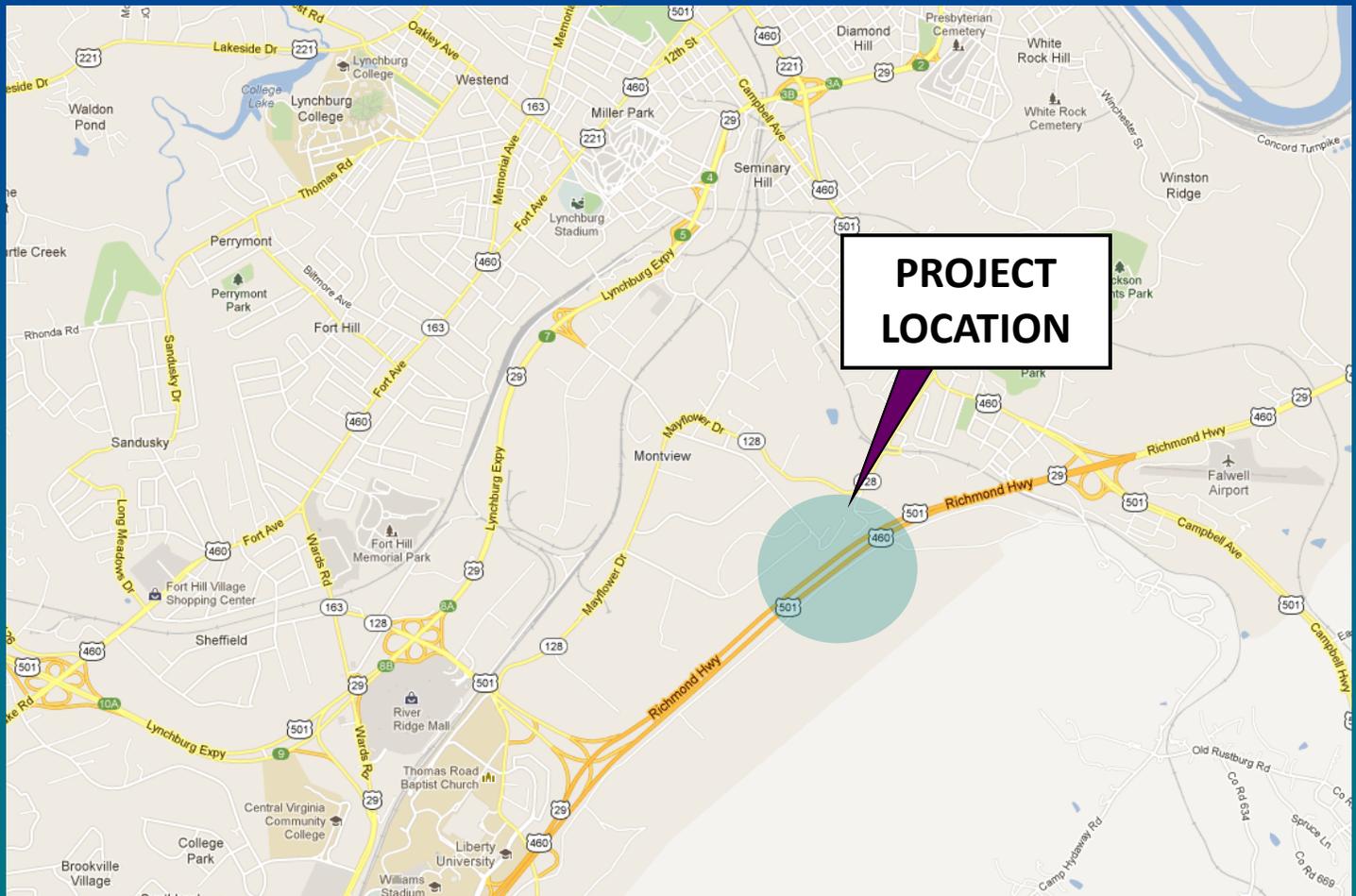


INTERCHANGE JUSTIFICATION REPORT FOR Route 460 / Odd Fellows Road City of Lynchburg, Virginia



Prepared for
VIRGINIA DEPARTMENT OF TRANSPORTATION

December 2012

**Interchange Justification Report
For
Route 460 / Odd Fellows Road
City of Lynchburg, Virginia**

Uniform Project Code: 100023

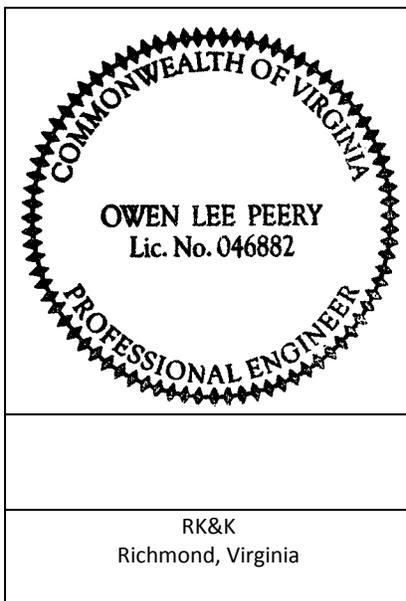
State Project Number: 0460-118-217, P101, R201, C501

Federal Project Number: STP-5118(209)

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January 4, 2013



Route 460 / Odd Fellows Road Interchange Justification Report

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EXECUTIVE SUMMARY

The Virginia Department of Transportation (VDOT) and the City of Lynchburg have identified the need for a new interchange along Route 460 / Route 29 / Route 501 (Richmond Highway and heretofore referred to as “Route 460”) at the proposed extension of Odd Fellows Road. Particularly since the completion of the Route 29 (Madison Heights) Bypass, the overlap section of Route 460 and Route 29 has served as the primary regional route for commercial and passenger traffic in the City of Lynchburg. Current daily traffic along this route is 36,300 vehicles per day (8% truck traffic). Access to this route is seen as critical for the trucking intensive industries located in and around the First Lynchburg Industrial Park, located along Mayflower Drive and Odd Fellows Road within the Study Area. Existing access to Route 460 is via Candler’s Mountain Road, a heavily travelled corridor which also serves as a primary access route to several retail centers and Liberty University. The reliance on Candler’s Mountain Road for access to this mix of industrial, retail, and educational land uses has resulted in congestion and high crash rates along that corridor. The proposed interchange is intended to reduce the use of Candler’s Mountain Road for access to the industrial area, and in turn reduce congestion and improve safety along Candler’s Mountain Road. The purpose of the proposed interchange is to address these existing and future operational, safety, and access needs which have identified within the Study Area. Future economic development within the Study Area is believed by project stakeholders to be closely linked to the need for improved access to Route 460. Additional detail on the need for the project is documented in Chapter 1.

This Interchange Justification Report (IJR) assesses the operations and safety of the proposed interchange and evaluates its impacts on the adjacent roadway network. Upon approval of this IJR and required NEPA documentation, it is VDOT’s intention to proceed with the final design and construction of the extension of Odd Fellows Road and the new interchange at Route 460. The NEPA document for the proposed improvements is an Environmental Assessment (EA). The draft EA is scheduled to be completed, with a public hearing to be held, in January 2013. The Final EA and Finding of No Significant Impact (FONSI) are anticipated in Spring 2013.

The selection of the Preferred Alternative is documented in Chapter 4. A number of potential feasible Build Alternatives were developed for comparison to the No Build Alternative; each of these Build Alternatives would satisfy the improved access component of the project purpose by facilitating a more direct connection from Route 460 to the adjacent industrial land uses north of Route 460 and undeveloped land south of Route 460. The Build Alternatives included several variants of a diamond interchange and a partial cloverleaf interchange design. After an assessment of the various concepts in terms of traffic operations, safety, and cost and constructability, Alternative 3 (Diamond) was selected as the Preferred Alternative, in consultation with the City of Lynchburg and other local stakeholders. Alternative 3 consists of a diamond interchange between Odd Fellows Road and Route 460. Odd Fellows Road will pass over Route 460 on structure. The ramp terminal intersections along Odd Fellows Road will be unsignalized, with stop control along the off-ramps. As part of the project, Odd Fellows Road will be extended approximately 360 feet south of the eastbound Route 460 ramp terminal and terminate at a single-lane roundabout, which will be designed and constructed to accommodate future connections from the east (Top Ridge Road) and the west (future Liberty University connector road). Future year traffic forecasts were generated for the No Build and Build Alternatives for Opening Year 2016 and Design Year 2035 scenarios. The No Build forecasts were developed by applying background traffic growth rates, obtained from the Lynchburg Area Travel Demand Model (LATDM), to the existing traffic counts. The Build traffic forecasts were obtained by shifting traffic between roadways within Study Area based on patterns observed in the LATDM. Additionally, trips expected to be generated by

future development within the Liberty University expansion area south of Route 460 were assigned to the network via the proposed interchange at Odd Fellows Road and Route 460. Full details regarding the development of the future traffic forecasts for this study are provided in Chapter 6. Additional information regarding existing land use and potential development in the Study Area is provided in Chapters 3 and 8.

The No Build and Build Alternatives were analyzed using a variety of analysis tools, including the methodologies in the Highway Capacity Manual (2010 Edition) and microsimulation with *SimTraffic* and *VISSIM*. Analyses were conducted for the mainline Route 460 freeway segments and ramp junctions (merge and diverge areas); analyses were also conducted for the Route 460 ramp terminal intersections along Odd Fellows Road as well as four (4) existing intersections along Candler's Mountain Road, Odd Fellows Road, and Campbell Avenue. Details on the selection of the traffic analysis tools used in the analysis are provided in Chapter 2. Safety analyses for the No Build and Build Alternative were conducted for this report utilizing FHWA's *Surrogate Safety Assessment Model (SSAM)*, which provided a quantitative comparison of the expected safety performance of the No Build and Build Alternatives.

Operational analyses were conducted for existing (2011), Opening Year (2016), and Design Year (2035) conditions. The results of the traffic operational analyses were evaluated based on guidance from an FHWA memorandum titled "Design Criteria – Level of Service" dated March 19, 2001. This memorandum summarizes the level of service requirements for projects on the National Highway System (NHS), which includes Interstate highways. Per this memorandum, the requirement for urban areas is Level of Service (LOS) C for mainline lanes and LOS C for auxiliary facilities (including ramps, turn lanes, and cross-road intersections). Throughout this IJR, "acceptable" operations are defined as LOS C or better and "unacceptable" operations are defined as LOS D or worse for all facilities. Full details regarding the existing and future year operational analyses are documented in Chapter 3 and Chapter 7.

Overall, the Design Year (2035) operational analyses indicate that each component of the proposed interchange at Route 460 / Odd Fellows Road will operate acceptably (LOS C or better). Due to the changes in traffic patterns within the Study Area anticipated due to the proposed interchange (and the opportunities for new development south of Route 460 which would generate additional traffic along the corridor), operations along Route 460 (freeway segments and ramp junctions) would worsen slightly compared to the No Build Alternative. However, no freeway segments or ramp junctions along Route 460 would be projected to operate worse than LOS D. Additionally, the intersection analysis results indicate improved operations at several existing intersections along the local street network, including Candler's Mountain Road and Campbell Avenue. Improved operations and reduced congestion along the local street network satisfies one of the project purposes identified in Chapter 1.

The results of the safety analysis using the *SSAM* indicate that despite the increase in traffic along Route 460 associated with the Build Alternative, the total number of expected crashes at the existing ramp junctions at the Candler's Mountain Road and Campbell Avenue interchanges would be unchanged from the No Build Alternative. Additionally, the analysis indicates that the expected number of crashes at four (4) key existing intersections within the Study Area would decrease by 13 percent in the Design Year between the No Build and Build Alternatives. This includes an expected reduction in Design Year crashes of 31 percent at the Candler's Mountain Road / Mayflower Drive intersection. These results are detailed fully in Section 7.5.2. The results indicate that the proposed Build Alternative would satisfy the safety component of the project purpose by reducing the expected number of crashes along the local roadway system (which experiences crash rates which exceed the statewide average for similar facilities).

FHWA Eight Policy Points Summary

The following section of the report outlines the eight (8) policy requirements listed in the Federal Register (Vol. 74, August 27, 2009) as they apply to the Route 460 / Odd Fellows Road interchange. These criteria are reviewed by VDOT and FHWA when approving requests for new or modified access points on limited access facilities:

1. *The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands (23 CFR 625.2(a)).*

The need being addressed by this project is detailed in Chapter 1 of this IJR. The needs are improved access to the industrial areas including the First Lynchburg Industrial Park (north of Route 460) and undeveloped land south of Route 460, reduction in traffic volumes and congestion along the local roadway network, particularly Candler's Mountain Road and Mayflower Drive, and improvements in safety along the local roadway network. The access improvements are closely linked to the need for future economic development within the Study Area. The existing interchanges along Route 460 are currently used to access the industrial area; however, Candler's Mountain Road also serves as the primary access to the River Ridge Mall (and several other retail centers) as well as Liberty University. This combination of access to three major employment and activity centers along Candler's Mountain Road means that access to each of the three is hindered. Access to the industrial park and surrounding area from the interchange to east along Route 460 at Campbell Avenue is constrained by the geometric deficiencies (and residential land uses) along Mayflower Drive east of Odd Fellows Road. The proposed new access along Route 460 would provide a new, enhanced connection between Route 460 and the industrial area that the existing interchanges or improvements to the local roadway system could not provide. Without this new access, further development within the industrial areas and new development in the vacant land south of Route 460 would be less viable.

2. *The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access (23 CFR 625.2(a)).*

Transportation System Management (TSM) typically involves the identification of minor enhancements to the existing transportation system that could alleviate localized operational deficiencies. For freeway corridors, TSM strategies could include traffic surveillance and monitoring equipment, incident management programs, High-Occupancy Vehicle (HOV) lanes, ramp metering, or signing and pavement marking improvements. Corridor and system-wide TSM strategies may include Intelligent Transportation Systems (ITS), improved mass transit service, and/or multi-modal facilities.

As noted under Point #1 above, TSM alternatives alone will not address the purpose and need of this project. New access is needed to address the project purpose and need to enhance access from Route 460. The Build Alternative does not preclude the adoption of future TSM strategies at this interchange or along the Route 460, which may include enhanced ITS systems, improved regional transit service, and/or multi-modal enhancements. Therefore, the proposed Build Alternatives satisfy the intent of FHWA's Policy Point #2. It should also be noted that a surveillance camera system with digital message board signs along Route 460 is currently under development.

3. *An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).*

Operational analyses were performed for the proposed Route 460 / Odd Fellows Road interchange as summarized in this Executive Summary and presented in detail in Chapter 7. Each component of the proposed Route 460 / Odd Fellows Road interchange is projected to operate acceptably (LOS C or better) in the Opening and Design Years. The analysis also included the adjacent interchanges along Route 460 and several existing intersections along the local street network. This analysis indicated that the Build Alternative would result in improved operations at three (3) key existing intersections within the Study Area compared to the projected No Build conditions. One intersection, Odd Fellows Road at Mayflower Drive, was identified which would be negatively impacted by the proposed Build Alternative. Two options to improve this intersection to mitigate the potential negative impact have been identified.

A safety analysis was also performed for the study segment of Route 460 and the local streets within the Study Area (See Sections 3.8 and 7.5). This analysis was based on a review of recent crash data as well as a quantitative analysis of future safety conditions using the Surrogate Safety Assessment Model (SSAM). The safety analysis indicated that the proposed interchange at Route 460 / Odd Fellows Road would not negatively impact safety along Route 460. Additionally, by changing traffic patterns within the Study Area and reducing traffic congestion along Candler's Mountain Road, the proposed improvements would also be expected to reduce the potential for crashes along on that corridor.

A conceptual signing plan has been developed for the proposed improvements and has been included in Appendix F of this IJR.

4. *The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g. transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)).*

The proposed improvements will provide a diamond interchange between Route 460 and the extension of Odd Fellows Road, a public street maintained by the City of Lynchburg. Odd Fellows Road will be extended to the south of Route 460, with accommodations for future connections to the east and west. The proposed improvements are being designed to satisfy all relevant AASHTO and VDOT design criteria. However, due to existing geometric constraints along the Route 460 corridor, several exceptions or waivers to these criteria may be needed. One potential Design Exception, for superelevation along Route 460, and two potential Design Waivers, for inside shoulder width and median clear zone width, have been identified to date. Additionally, Access Management waivers will be needed along Odd Fellows Road both north and south of the proposed interchange.

5. *The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.*

Transportation improvements in the project area are guided by a number of state, regional, and local plans and strategies. These plans were reviewed to determine whether the proposed Route 460 / Odd Fellows Road interchange is consistent with the goals and objectives of those plans. The preferred alternative was found to be consistent with the following state, regional and local plans:

- Central Virginia Metropolitan Planning Organization (CVMPO) *Long Range Plan*
 - City of Lynchburg Department of Community Planning and Development *2002-2020 Comprehensive Plan*
 - Virginia Final Transportation Six-Year Improvement Program, FY 2013-2018
6. *In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 109(d), 23 CFR 625.2(a), 655.603(d), and 771.111).*

The Route 460 / Odd Fellows Road interchange is the only new access currently envisioned within the study segment of Route 460.

7. *When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603 (d)). The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603 (d)).*

This request for new access along Route 460 at Odd Fellows Road interchange is not associated with a specific proposal for new development in the Study Area. The addition of this interchange is meant to address safety and operational concerns along adjacent facilities, notably Candler's Mountain Road, improve access (particularly for truck traffic) between Route 460 and the industrial facilities in and around the First Lynchburg Industrial Park located along Odd Fellows Road / Mayflower Drive, and improve overall system connectivity within the City of Lynchburg. Addressing these existing needs would also be expected to enhance economic development in the Study Area; it should be noted that the City and Liberty University do have future plans to develop the unused land around the proposed interchange.

While a specific development is not the primary reason for the proposed construction of a new grade-separated interchange at Route 460 and Odd Fellows Road, sufficient coordination has occurred to ensure that the future development potential of the Study Area has been appropriately considered in this analysis. As detailed in Chapter 6, additional traffic expected to be generated by future development within the Study Area has been included in the future year traffic volume forecasts. This development was accounted for through the future demographic projections in the regional model and trip generation for potential development within the Liberty University expansion area. As detailed in Chapter 7, capacity analyses were conducted to determine that the proposed roadway network configuration could accommodate the future traffic volumes within the Study Area.

8. *The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111).*

The required environmental document for the Route 460 / Odd Fellows Road Interchange Project is an Environmental Assessment (EA). VDOT is currently compiling the environmental document, including all necessary air quality and noise quality analyses, and expects to complete the draft EA in January 2013. The Final EA and Finding of No Significant Impact (FONSI) are expected to be completed in June 2013.

1. INTRODUCTION

1.1. Background

The Virginia Department of Transportation (VDOT) and the City of Lynchburg have identified the need for a new interchange along Route 460 / Route 29 / Route 501 (Richmond Highway and heretofore referred to as "Route 460") at the proposed extension of Odd Fellows Road. Particularly since the completion of the Route 29 (Madison Heights) Bypass, the overlap section of Route 460 and Route 29 has served as the primary regional route for commercial and passenger traffic in the City of Lynchburg. The current daily traffic volume along this route is 36,300 vehicles per day (8% trucks). Access to this route is seen as critical for the trucking intensive industries located within the industrial areas including the First Lynchburg Industrial Park Employment District, located along Mayflower Drive and Odd Fellows Road within the Study Area. Existing access to Route 460 is via Candler's Mountain Road, a heavily travelled corridor which also serves a major access to several retail centers and Liberty University. The reliance on Candler's Mountain Road for access to this mix of industrial, retail, and educational land uses has resulted in congestion and high crash rates along that corridor. The proposed interchange is intended to reduce the use of Candler's Mountain Road for access to the industrial area, and in turn reduce congestion and improve safety along Candler's Mountain Road.

The proposed new interchange is consistent with a February 2001 report prepared by the VDOT Transportation Planning Division which recommended the extension of Odd Fellows Road, a new diamond interchange with Route 460, and access to Top Ridge Road (State Route 837). The Central Virginia Metropolitan Planning Organization's (CVMPO) Long-Range Transportation Plan (2005), which sets forth a blueprint for the growth and management of central Virginia's transportation system through the year 2030, lists the project as a top-priority Tier 1 Transportation Vision Plan Project. The project is also listed as a Primary Project in the Central Virginia Transportation Improvement Program (2011). The City of Lynchburg Department of Community Planning & Development includes the project in its *Comprehensive Plan 2002-2020*.

FHWA review and approval of the proposed new access to Route 460, a part of the National Highway System (NHS), is not required because the project is non-Interstate and the anticipated construction cost is less than \$25 million. However, per VDOT's Informational and Instructional Memorandum 200.5, an Interchange Justification Report (IJR) is required for approval of the access changes by VDOT's Chief Engineer. This IJR assesses the operations and safety of the proposed interchange and evaluates its impacts on the adjacent roadway network. Upon approval of this IJR and the required NEPA document, it is VDOT's intention to proceed with the final design and construction of the extension of Odd Fellows Road and the new interchange at Route 460.

For reference purposes, the IJR and preliminary design efforts are performed under the following VDOT project tracking numbers:

State Project Number:	0460-118-217, P101, R201, C501
UPC Number:	100023
Federal Project Number:	STP-5118(209)

The Route 460 at Odd Fellows Project is included in VDOT's FY 2013 – 2018 Six-Year Improvement Program (SYIP). Currently, \$31.715 million has been allocated to this project through FY 2018. The

\$2.217 million Preliminary Engineering (PE) effort is underway. Right-of-way acquisition (anticipated at \$6.66 million) is scheduled to commence in FY 2014, and construction totaling \$22.838 million, is currently anticipated to commence in FY 2014.

1.2. Project Purpose

The purpose of the proposed interchange is to address existing and future operational, safety, access, economic development, and system connectivity needs which have been identified within the Study Area. Future economic development within the Study Area is believed by project stakeholders to be closely linked to the need for improved access to Route 460.

The **operational** needs intended to be addressed by the proposed interchange include existing and future projected congestion along the Candler's Mountain Road corridor; this congestion would be centered on the intersection with Mayflower Drive, which is currently heavily utilized by cars and trucks to access the industrial areas along Mayflower Drive and Odd Fellows Road as well for access to Liberty University. Reduction in traffic along both Candler's Mountain Road and Mayflower Drive associated with the proposed new interchange would reduce congestion and delay for users along the Candler's Mountain Road corridor.

The proposed interchange is also intended to help address existing and future **safety** concerns within the Study Area. The existing crash rate along Candler's Mountain Road exceeds the statewide average for similar facilities by almost 700 percent. During a recent three-year period, over 256 crashes, resulting in 36 injuries, were reported along this corridor. The types of crashes frequently reported along Candler's Mountain Road include rear-end and angle collisions. These crash types are frequently associated with recurring congestion along a corridor. Reduction in congestion along Candler's Mountain Road may have a corresponding safety benefit, in terms of reduced crashes, along the corridor.

The proposed interchange at Odd Fellows Road and Route 460 is also intended to address **access** deficiencies within the Study Area which cannot be addressed by improvements to the local road system alone. Odd Fellows Road serves as an entrance to the industrial areas that include the First Lynchburg Industrial Park and the sole access point to over twenty commercial properties. However, there is no direct access from Route 460 to Odd Fellows Road or Mayflower Drive. Trucks currently travel a circuitous route to and from the industrial and commercial properties located along these roadways. Much of the traffic which seeks access to the Study Area from eastbound Route 460 uses the Candler's Mountain Road interchange west of the Study Area. Conversely, traffic seeking access to the Route 460 Bypass from the Study Area uses Candler's Mountain Road via Mayflower Drive. Poor roadway geometrics and adjacent residential land uses along on Mayflower Drive between Odd Fellows Road and Campbell Avenue serve to hinder access to the Study Area from westbound Route 460, resulting in additional use of Candler's Mountain Road (as opposed to Campbell Avenue). As a result, truck traffic moving to and from industrial sites in the study area mixes with traffic moving to and from the Candler's Mountain Road commercial areas and Liberty University, which contributes to the operational and safety problems along Candler's Mountain Road.

The proposed interchange is also needed to provide improved access to currently undeveloped land located south of Route 460 in the City of Lynchburg and Campbell County. Much of this land is currently owned by Liberty University and has been identified as an area for future expansion. Liberty is currently planning to provide access to this area via a frontage roadway from Candler's Mountain Road. This will further increase traffic volumes attempting to access Route 460 at the interchanges to the west and

likely further increase congestion along the Candler's Mountain Road corridor. The proposed interchange would provide additional access to this undeveloped land.

The result of the access limitations in the Study Area may be to hinder existing and future **economic development** within the Study Area. The 2001 VDOT study concluded that without the proposed interchange:

- Development of the area along Mayflower and Odd Fellows Road will continue to be slow and sporadic.
- The area will remain unattractive to new industry due to slow travel time associated with current access.
- Difficulties will continue in recruiting new industry to an area that has the greatest potential of visual exposure but lacks sufficient access to the premiere transportation corridor in the Lynchburg area.

The proposed interchange would also provide an additional connection between the Route 29 Business (Lynchburg Expressway) and Route 460 corridors. This additional connection could be used as an alternate route for emergency responders (to avoid potential congestion along Candler's Mountain Road) and as an alternate route during construction and maintenance activities along Candler's Mountain Road. It would also provide motorists additional route choices during peak periods and potentially help alleviate congestion along existing heavily travelled corridors. This improved **system connectivity** would enhance overall mobility throughout the Study Area.

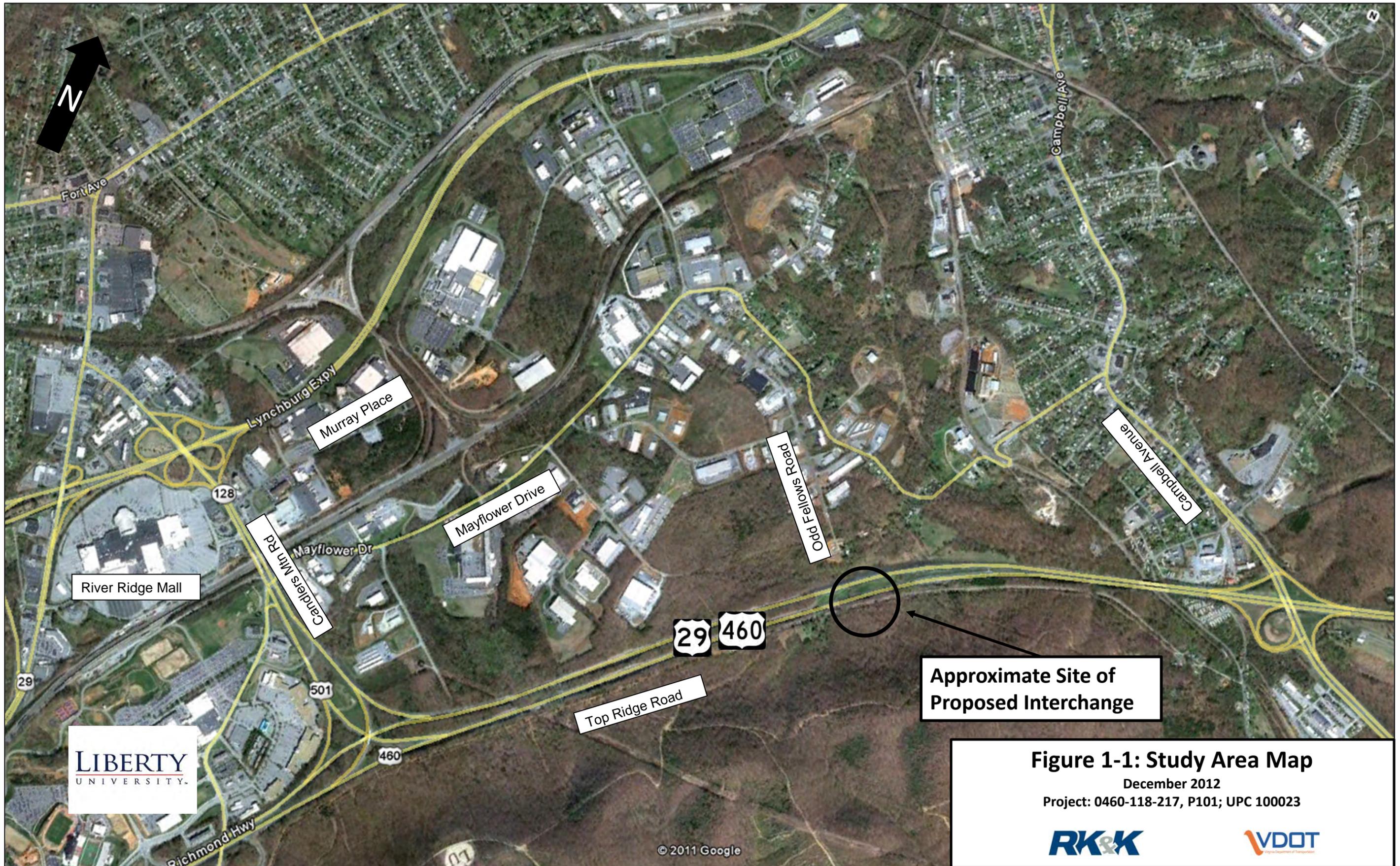
1.3. Project Location

The Route 460 / Odd Fellows Road interchange sits on the southern edge of the jurisdictional limits of the City of Lynchburg. The proposed interchange is located approximately 1 mile southwest of the Route 460 / Campbell Avenue interchange and approximately 1 mile northeast of the Route 460 / Candler's Mountain Road interchange. For the purposes of this IJR, Route 460 is assumed to run in an east-west direction, and Odd Fellows Road is assumed to run in a north-south direction. The Study Area for this IJR includes the following roadway segments:

- Route 460: From west of the Candler's Mountain Road interchange to east of the Campbell Avenue interchange
- Odd Fellows Road: From Top Ridge Road to north of Mayflower Drive
- Candler's Mountain Road: From Route 460 to north of Mayflower Drive

The Study Area encompasses an industrial area which includes First Lynchburg Industrial Park, an important industrial and commercial area within the City of Lynchburg. Route 460 is a limited access highway classified as Urban Principal Arterial. Odd Fellows Road and Mayflower Drive, both considered Urban Minor Arterials, provide access to properties north of Route 460. Top Ridge Road (State Route 837) is a partially paved road located on the south side of the Route 460 Bypass within the Study Area.

Figure 1-1 shows a map of the Study Area, which is comprised primarily of undeveloped land to the south owned by Liberty University and industrial uses to the north between Candler's Mountain Road and Campbell Avenue.



Approximate Site of Proposed Interchange

Figure 1-1: Study Area Map

December 2012

Project: 0460-118-217, P101; UPC 100023



2. METHODOLOGY

This Interchange Justification Report (IJR) was developed following the applicable VDOT and FHWA criteria. This request adheres to the regulations and guidance provided in the August 31, 2010 FHWA Memorandum, “Interstate System Access Information Guide” and addresses the eight (8) policy points detailed in the August 27, 2009 update to the Federal Register. Additionally, this request follows the organizational structure identified in the VDOT Instructional and Informational Memorandum (I&IM) 200.5.

2.1. Related Studies

The following studies were reviewed for their applicability to the proposed modifications to the Route 460 / Odd Fellows Road interchange. Relevant data from these studies were used as appropriate to support the development of this IJR:

- Central Virginia Long-Range Transportation Plan – Year 2035
 - Key Information: Projects for inclusion in future year travel demand model

2.2. Key Assumptions

Key assumptions used to develop this IJR were previously documented in an IJR Scoping Document which was submitted to VDOT on December 8, 2011. The IJR Scoping Document is included in Appendix A. A brief summary of the key assumptions used to develop this IJR follows:

Study Area: The proposed improvements cover a distance of approximately one mile along Route 460 and approximately one-quarter mile along existing Odd Fellows Road and include a new bridge over Route 460. The study area to be analyzed for the IJR will include mainline Route 460 between the Candler's Mountain interchange to the west and the Campbell Avenue interchange to the east. Odd Fellows Road will be analyzed from just south of the proposed Route 460 interchange to the existing interchange at Route 29 Business to the north; this segment includes the signalized intersection at Mayflower Drive (the study will identify potential improvements at this intersection to accommodate the change in traffic patterns associated with the interchange). Candler's Mountain Road will be analyzed from Mayflower Drive to Route 460. This Study Area was identified in the IJR Scoping Document.

Opening Year and Design Year: A project Opening Year of 2016 and a Design Year of 2035 (advertisement date + 22 years) were assumed for this Study.

Peak Periods for Analysis: The weekday AM and PM peak periods were identified as the critical periods for analysis. These peaks were selected due to higher total traffic volumes compared to the weekend peak periods. Furthermore, the land uses of the area surrounding the proposed interchange at Route 460 and Odd Fellows Road are types which typically generate higher traffic volumes during the weekday peak periods (including industrial and truck-oriented land uses).

Traffic Data: Updated traffic volume data throughout the Study Area was obtained in November 2011. Additional information regarding the traffic volume data can be found in Chapters 3 and 6.

Crash Data: Crash data for this IJR was gathered from two different sources. Along Route 460, crash data was provided by VDOT for the calendar years of 2007 and 2008. The City of Lynchburg provided crash data for a three-year period from November 1, 2008 through October 31, 2011 for Candler's Mountain Road, Mayflower Drive, and for Odd Fellows Road (the time period beginning in February 2009 and ending in August 2011). Additional information on the crash data and analysis can be found in Chapter 3.

Future Traffic Forecasts: The Opening Year and Design Year traffic forecasts for this study were developed using the following process. The first step involved developing an existing network of traffic volumes based on the field-collected count data; these included both average daily traffic (ADT) and peak hour volumes. The existing volumes were used to establish truck percentages, directional distributions, and k-factors (% of daily traffic occurring during the peak hours) for the Study Area. Then, the Lynchburg Area Travel Demand Model (LATDM) was used to determine future traffic growth rates for the roadways within the Study Area. These growth rates were applied to the existing ADTs to produce a set of future daily volumes for Opening Year (2016) and Design Year (2035) No Build conditions. The future peak hour volumes were generated by applying k-factors (determined based on existing count data) to the average daily traffic volumes. K-factors were applied separately for each peak hour (AM and PM), as opposed to simply reversing traffic volumes from one peak to the other, because the count data revealed a lack of reverse peak period directionality within the Study Area.

Opening Year (2016) and Design Year (2035) traffic volumes for the Build Alternatives were projected by reviewing the changes in traffic patterns observed within the LATDM after modifying the roadway network to include the proposed Route 460 / Odd Fellows Road interchange. These trends were then used to shift traffic between roadways within the Study Area. Additionally, trips from Liberty University's preliminary plans for future development in the interchange area were included in the Build Alternative traffic forecasts. A complete summary of the traffic forecasting process used to develop the volumes for this study can be found in Chapter 6.

Future Transportation Network Improvements: Other than the proposed Route 460 / Odd Fellows Road Interchange, this IJR also identified a need for improvements to the signalized intersection of Odd Fellows Road and Mayflower Drive to accommodate the increased traffic volume expected along Odd Fellows Road once the interchange opens to traffic. Additional detail on the improvements assumed under the Build Alternative can be found in Chapters 4 and 5.

2.3. Traffic Analysis Methodology

The nature of the proposed improvements and the specific topographic and traffic characteristics of the Study Area indicate that the Highway Capacity Manual methodologies are appropriate for evaluating operations for this IJR. Therefore, the approved IJR Scoping Document identified *HCS* and *Synchro* as the analysis tools for evaluating traffic operations for this interchange and the surrounding roadways.

Mainline Route 460 Operations and Ramps: Based on a review of the specific characteristics of this project and the alternatives likely to be considered, it was concluded that the *HCS 2010* software would be most appropriate to evaluate operations along Route 460. *HCS* provides spot analyses of locations along the corridor, including freeway segments and ramp junctions (merge and diverge areas). Key measures of effectiveness from *HCS 2010* evaluated for this IJR include density (passenger cars/mile/lane) and level-of-service (LOS). These MOEs were used to compare the No Build and Build

Alternatives and to verify that the proposed modifications will provide safe and efficient operations along the freeway. The results of the *HCS* analyses are summarized in Chapters 3 and 7 of this report.

Local Roadway Network: Utilizing the standard methodologies presented in the 2010 Highway Capacity Manual, the software package *Synchro Version 8 (Build 801, Revision 563)* was utilized to assess operations at the intersections within the Study Area. Measures of effectiveness reported from *Synchro* (applying the HCM Reports feature) for the signalized and unsignalized intersections along Odd Fellows Road, Campbell Avenue, and Candler's Mountain Road include level of service (LOS) and delay. Additionally, the companion *SimTraffic* software package was utilized to estimate the maximum/95th-percentile queue lengths for the study intersections. At the proposed ramp terminal intersections, the simulated delays and queues were used to confirm that the interchange would operate efficiently and that sufficient turn lane storage is provided as part of the project design. An average of five (5) one hour runs with a 15-minute seeding period was used to develop the *SimTraffic* results. Additional information regarding the operations of the local roadway network and ramps can be found in Chapters 3 and 7.

Supplemental Microsimulation Analysis Using VISSIM: It was noted that the analyses performed using the *HCS 2010* software do not account for the potential impacts of upstream or downstream bottlenecks of a freeway segment or junction. Therefore, the microsimulation tool *VISSIM* (Version 5.30) was utilized to develop a simulation model of the entire corridor which can be used to evaluate the overall operations and the interaction between segments. Key measures of effectiveness from *VISSIM* evaluated within this IJR include density (vehicles/mile/lane), speed (miles per hour) and level-of-service (LOS). These MOEs were used to compare the No Build and Build Alternatives and validate the results determined from the *HCS 2010* analysis. The *VISSIM* model was also used to develop vehicle trajectories for key locations in the Study Area. Those trajectories were then exported to the *Surrogate Safety Assessment Model (SSAM)* and used to compare the expected crash frequencies for the No Build and Build Alternatives.

3. EXISTING CONDITIONS

3.1. Demographics

The Route 460 / Odd Fellows Road interchange Study Area is located in the City of Lynchburg. In 2010, Lynchburg's population was approximately 75,570, and there were approximately 32,000 housing units located within the City. The jurisdictional line separating the City and Campbell County is approximately 2,150 feet south of the Route 460 centerline. The 2010 population for Campbell County was approximately 54,840 with approximately 24,770 housing units.

Adjacent to the Study Area for this IJR are a few large employment generators. First, located just to the west of the Study Area is Liberty University. This is a major university with enrollment serving 13,400 undergraduates, 5,800 graduate students and an academic staff approaching 2,000.

Also within the Study Area are many trucking-oriented and industrial business located along Odd Fellows Road and Mayflower Drive, particularly those operating within the industrial area including the First Lynchburg Industrial Park.

3.2. Existing Land Use

To the south of Route 460, the land uses in the Study Area are currently zoned R-2 (Low-Medium Density Single-Family Residential) and R-C (Resource Conservation). Most of this area is located on the northern slope of Candler's Mountain and is currently unused land. To the north of Route 460, almost all of the land uses are zoned and operating I-2 (Light Industrial) and I-3 (Heavy Industrial). There are numerous warehouse, distribution, and other facilities located within this area which generate substantial numbers of truck trips which utilize the local road system (Odd Fellows Road, Mayflower Drive, and Candler's Mountain Road) to access major regional freeway facilities including Route 460 and the Lynchburg Expressway (Route 29 Business).

Located west of the Study Area, along both sides Route 460 is an area zoned as B-5 (General Business) which operates as Liberty University. It is not expected for this land use to change. On the western fringe of the Study Area is Candler's Mountain Road which is a crucial transportation artery connecting Route 460 and Business Route 29. The predominant developed land use along this corridor is zoned B-5 and includes the River Ridge Mall and Candler's Station Shopping Center.

Additional detail on the existing and future proposed land use within the Study Area can be found in Chapters 6 and 8.

3.3. Existing Roadway Network

The Study Area for this IJR includes roadways of varying types, ranging from Urban Principal Arterials to partially paved local facilities as discussed below:

Route 460: Route 460 is classified by FHWA as an Urban Freeway or Expressway within the Study Area. Route 460 serves a major east-west corridor through central portions of Virginia. Route 460 connects Blacksburg in western Virginia to Chesapeake in eastern Virginia, running through Petersburg along the

way. Within the Study Area, Route 460 is a four-lane (two lanes in each direction) limited-access facility with a posted speed limit of 65 miles per hour.

Odd Fellows Road: Odd Fellows Road is a two-lane road (one lane in each direction) classified as an Urban Minor Arterial that provides access to properties north of the Route 460. To the north, Odd Fellows Road terminates at Business Route 29. Currently, Odd Fellows Road has numerous unsignalized intersections and commercial driveways. There is one existing signalized intersection at Mayflower Drive.

Route 128 (Mayflower Drive): Mayflower Drive is a two-lane road (one lane in each direction) classified as an Urban Minor Arterial. It runs parallel to Route 460, connecting Candler's Mountain Road to Campbell Avenue. There are numerous commercial and residential driveways along the corridor. There are existing signalized intersections at Candler's Mountain Road, Odd Fellows Road, and Campbell Avenue. There is also an at-grade rail crossing located between Odd Fellows Road and Campbell Avenue.

Route 837 (Top Ridge Road): Top Ridge Road (Route 837) is a partially paved road located on the south side of Route 460 within the Study Area. It currently provides access to several residential properties and utilities within the Study Area.

Route 501 (Candler's Mountain Road): Candler's Mountain Road is a four-lane road (two in each direction) classified as an Urban Other Principal Arterial running north-south with a southern terminus at Route 460. This facility has a signalized intersection at Mayflower Drive within the Study Area and continues north to Business Route 29.

Route 501 (Campbell Avenue): Campbell Avenue is a four-lane road (two in each direction) classified as an Urban Other Principal Arterial south of Route 460, and an Urban Minor Arterial north of Route 460. Within the Study Area, Campbell Avenue has a signalized intersection with the Route 460 westbound ramps and an unsignalized intersection with the eastbound off-ramp from Route 460.

3.4. Alternative Travel Modes

There are few options within the Study Area and surrounding area for the use of alternative travel modes.

Rail Service: No intracity passenger/commuter rail service is available in or around our Study Area. However, Lynchburg does have an Amtrak station which runs on a line between Charlottesville and Danville. Amtrak service is available to Washington, D.C. on a daily basis.

Bus Service: The City of Lynchburg has ten (10) bus routes which are operated throughout the City by the Greater Lynchburg Transit Company (GLTC). The GLTC routes operating in or around our Study Area are Routes 2, 4F and 9.

Route 2 begins at The Plaza downtown and travels down Campbell Avenue before turning down Florida Avenue, the first signal north of Route 460. This route begins circulating at 5:45 AM and ends at 9:11 PM with a route of approximately 30 minutes, and one hour headways between buses during the beginning and ending of the day, with 30 minute headways from 7:15 AM to 5:45 PM.

Route 4F begins at The Plaza in downtown and travels Fort Avenue to Wards Road, then behind River Ridge Mall to Candler's Mountain Road where it continues to University Boulevard before ending at Liberty University; the route reverses course and travels back downtown. This route begins circulating at 6:45 AM and ends at 8:40 PM with a route of approximately 55 minutes, and one hour headways between buses for the entire operating period.

Route 9 begins at The Plaza downtown and travels Fort Avenue to Wythe Road and then to Carroll Avenue before traveling to Odd Fellows Road. The route then follows Bradley Drive, Mayflower Drive, Candler's Mountain Road and Business Route 29. This route begins circulating at 7:45 AM and ends at 6:13 PM with a route of approximately 30 minutes, and one hour headways between buses for the entire operating period.

In terms of intercity bus routes, Lynchburg is on a Greyhound Bus Line that connects Lynchburg with Roanoke, VA and Richmond, VA. From there, connections are available to most major cities along Greyhound's bus service lines.

High-Occupancy Vehicle (HOV) Alternatives: No High-Occupancy Vehicle (HOV) lanes exist in or around the Study Area.

3.5. Interchanges

There are two existing interchanges along Route 460 located within the Study Area. A description of the configuration for each interchange is provided below:

Route 460 / Candler's Mountain Road Interchange: The Route 460 / Route 501 (Candler's Mountain Road) interchange is a directional T-interchange. For eastbound Route 460, the on and off-ramps are located on the left side of the freeway; each have approximately 600-foot long deceleration / acceleration lanes. For westbound Route 460, the on and off-ramps are located on the right side of the freeway; the westbound off-ramp includes a 400-foot of deceleration lane and the on-ramp includes a 500-foot acceleration lane. Each ramp is one lane with the off-ramps from both direction joining to create the two lanes of northbound Candler's Mountain Road, and the two on-ramps being formed by a split of the two lanes of southbound Candler's Mountain Road. This interchange is located approximately 1.2 miles southwest of the proposed Route 460 / Odd Fellows interchange.

Route 460 / Campbell Avenue Interchange: The Route 460 / Campbell Avenue Interchange is a partial cloverleaf interchange. The Route 460 eastbound off-ramp is a single lane ramp that splits into a channelized right turn/merge lane and a left turn lane. The Route 460 eastbound on-ramp from Campbell Avenue southbound is a single lane loop ramp with an acceleration lane and taper. The on-ramp to Route 460 eastbound from Campbell Avenue northbound is a single lane ramp that has an acceleration lane with a taper onto Route 460. The Route 460 westbound off-ramp has a taper and single deceleration lane that splits into two lanes, one for left turning vehicles and one for right turning vehicles. The on-ramp to Route 460 westbound is a single lane ramp with an acceleration lane and taper. Vehicles turning right onto the ramp are channelized and required to merge with the left-turning vehicles from the Campbell Avenue northbound approach. This interchange is located approximately 1.1 miles northeast of the proposed Route 460 / Odd Fellows interchange.

3.6. Existing Data

Existing traffic volume data was compiled from a variety of sources:

- 72-hour classification counts were collected in November 2011 for the following locations:
 - Route 460 (between Candler Mountain Road and Campbell Avenue)
 - Candler Mountain Road
 - Odd Fellows Road
 - All interchange ramps at:
 - Route 460 / Candler Mountain Road
 - Route 460 / Campbell Avenue
 - Route 29 Business / Odd Fellows Road
- AM and PM peak period turning movement counts were collected in November 2011 for the following locations:
 - Odd Fellows Road / Mayflower Drive
 - Candler Mountain Road / Mayflower Drive
 - Campbell Avenue / Route 460 Eastbound ramps
 - Campbell Avenue / Route 460 Westbound ramps

Based on the available data sources, a network of existing 2011 ADTs and AM and PM peak hour volumes were compiled. Additional detail regarding the existing traffic data collected for this study can be found in Chapter 6. The existing (2011) ADTs and peak hour volumes are summarized in Figures 6-2 and 6-3.

3.7. Operational Performance

Operational analysis for this IJR was conducted using the analysis tools *HCS 2010* and *Synchro Version 8 (Build 801, Revision 563)* as well as the microsimulation tools *VISSIM (Version 5.30)* and *SimTraffic*, the companion microsimulation tool for *Synchro*. *HCS 2010* and *Synchro* are based on the methodologies presented in the 2010 Highway Capacity Manual. The *HCS 2010* software was used for capacity analyses for freeway segments and ramp junctions within the Study Area. *Synchro* was used to assess the operations (in terms of Level of Service and delay) of the intersections within the Study Area. Supplemental analyses were conducted using *SimTraffic* and *VISSIM*. *SimTraffic* is a microsimulation tool linked to *Synchro* which is primarily used to simulate the operations of signalized arterial corridors; for this study, *SimTraffic* was used to evaluate operations of the proposed ramp terminals along Odd Fellows Road as well as queues at the intersections located along Candler Mountain Road, Odd Fellows Road and Campbell Avenue. *VISSIM* is a microsimulation modeling software developed by PTV Vision that is capable of representing traffic flow on roadway networks containing both surface streets and freeways. *VISSIM* is capable of assessing the interaction between adjacent segments, particularly under saturated or congested conditions, and can analyze various types of facilities (freeways, arterials) with a wide variety of geometric configurations.

3.7.1. Base Model Development and Calibration

The microsimulation traffic analysis in *VISSIM* was conducted based on the processes described in FHWA's Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software. A base *VISSIM* model was developed using existing scaled aerial photography for the project Study Area. The default *VISSIM* vehicle distribution was modified to match the vehicle classification

counts obtained for the Study Area. No other default parameters, including the parameters influencing driver behavior, were adjusted during the base model development.

The existing AM and PM peak hour volumes, summarized in Figure 6-3, were then input into *VISSIM* and the model was run using a 15-minute seeding period and a one hour recording period. This initial run was used to identify any coding errors. After correcting any errors, the models were run again and statistics were recorded to determine how closely the simulation matched the field observed traffic volumes and traffic speeds. Given the size of the study area, the Route 460 corridor was selected for use in calibration given that the speeds and volumes along this route are crucial for modeling the proposed interchange.

Table 3-1 includes a comparison of the field-observed AM and PM peak traffic volumes to the throughput observed in the existing AM and PM peak *VISSIM* models for each of the mainline freeway segments. The model volumes are based on an average of ten (10) simulation runs.

Table 3-1. Comparison of Field Conditions versus Model Conditions – Route 460

Location	Direction	Existing Volumes (Model Input)		Model Volumes (Model Output)		Percent Difference	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Route 460 – West of Candlers Mountain Road	EB	1,765	1,304	1,766	1,314	0.1%	0.8%
	WB	1,220	2,055	1,180	1,889	3.4%	8.8%
Route 460 –Candlers Mountain Road to Campbell Avenue	EB	1,221	1,636	1,240	1,599	1.5%	2.3%
	WB	1,594	1,713	1,611	1,732	1.1%	1.1%
Route 460 – East of Campbell Avenue	EB	1,013	1,578	1,038	1,552	2.4%	1.7%
	WB	1,523	1,396	1,529	1,407	0.4%	0.8%

The results in Table 3-1 indicate that the Route 460 freeway link volumes within *VISSIM* closely match the field observed AM and PM peak traffic volumes. The model-assigned volumes vary from the observed volumes by approximately three (3) percent or less for 11 of the 12 analyzed locations. The remaining section is within ten (10) percent, which is typically considered a reasonable level of deviation for simulated volumes. Similarly, the model assigned volumes for each of the interchange ramps at the existing interchanges along Route 460 within the Study Area were compared to the AM and PM peak field-observed volumes. This comparison is summarized in Table 3-2.

Table 3-2. Comparison of Field Conditions versus Model Conditions – Route 460 Interchange Ramps

Location	Existing Volumes (Model Input)		Model Volumes (Model Output)		Percent Difference	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Route 460 – Candler Mountain Eastbound Off-Ramp	925	408	916	402	1.0%	1.5%
Route 460 – Candler Mountain Eastbound On-Ramp	381	740	391	687	2.6%	7.7%
Route 460 – Candler Mountain Westbound Off-Ramp	716	463	686	439	4.4%	5.5%
Route 460 – Candler Mountain Westbound On-Ramp	342	805	357	733	4.2%	9.8%
Route 460 – Campbell Eastbound Off-Ramp	406	467	396	430	2.5%	8.6%
Route 460 – Campbell Eastbound (from Southbound) On-Ramp	133	346	143	345	7.0%	0.3%
Route 460 – Campbell Eastbound (from Northbound) Off-Ramp	65	63	63	59	3.2%	6.8%
Route 460 – Campbell Westbound Off-Ramp	413	207	401	206	3.0%	0.5%
Route 460 – Campbell Westbound On-Ramp	484	524	472	501	2.5%	4.6%

The results in Table 3-2 also indicate that the *VISSIM* assigned volumes for the existing (2011) AM and PM peak periods closely match the field-observed values along each of the interchange ramps. Volumes for 13 of 18 analysis points were within five (5) percent of the field observed counts with the remaining points within ten (10) percent of the field-collected data. Overall, the results of this evaluation indicated that the model volumes matched very well with the field conditions.

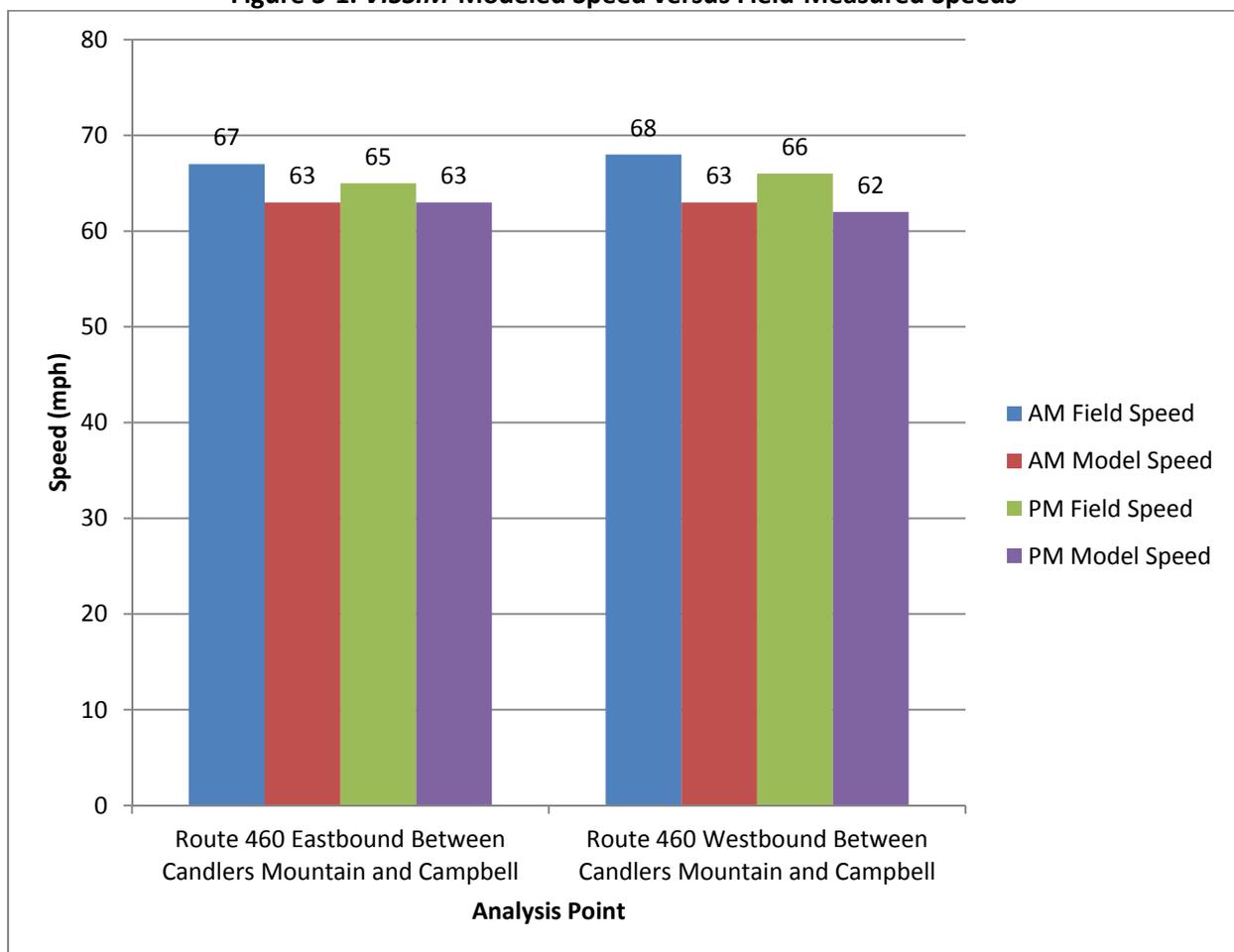
However, a comparison of the average *VISSIM*-modeled vehicle speeds (using one of *VISSIM*'s default speed distributions) indicated that the model was over-predicting the average travel speeds along Route 460. Therefore, to adjust the mainline speeds within the model, one of the default desired speed distribution curves within *VISSIM* was modified. The minimum and maximum desired speeds for passenger cars were set to 55 mph and 75 mph, respectively. These bounds were selected to represent a reasonable range of desired speeds on a high-speed freeway facility, with a posted speed of 65 mph. More importantly, the 15th-percentile speed, median speed (50th-percentile) and 85th-percentile speeds were adjusted to produce modeled speeds which closely matched the field-measured speeds for two locations during both the AM and PM peak hours. Table 3-3 summarizes the critical values input for the desired speed distribution for passenger car and truck traffic along Route 460.

Table 3-3. VISSIM Route 460 Mainline Desired Speed Distributions

Location	VISSIM Modified Speed Distributions (mph)
Minimum	55
15 th -Percentile	60
Median	65
85 th -Percentile	70
Maximum	75

After these adjustments to the desired speed distributions were completed, the existing AM and PM peak models were re-run and the average AM and PM peak speeds from VISSIM were compared to the existing average speeds along Route 460 between Candler's Mountain Road and Campbell Avenue. The field-observed versus modeled speed comparison is summarized in a bar chart in Figure 3-1.

Figure 3-1. VISSIM-Modeled Speed versus Field-Measured Speeds



The results in Figure 3-1 indicate that the modeled AM and PM peak hour speeds are within five percent of the average AM and PM peak field-observed speeds for each location and time period. Overall, it was determined that, with the adjusted desired speed distributions, the model was accurately reflecting peak period travel speeds along Route 460 within the Study Area. Given the lack of congestion or bottlenecks on Route 460 under existing conditions, calibration to the existing speeds at these critical

locations would be expected to provide high-quality calibration to travel times through the corridor as well.

Based on the modeled volumes and speeds, which closely reflect existing conditions, and visual inspection of the simulation to verify that queues matched field conditions it was determined that the models were sufficiently calibrated to conduct the detailed analyses for this study. The following sections document the analysis of existing AM and PM peak conditions.

It should be noted that no parameters (other than existing peak hour factors and truck percentages) were adjusted from the defaults in the software packages of HCS, Synchro or SimTraffic. The queues from SimTraffic and VISSIM appear to closely match those observed during site visits which were considered to have occurred under normal traffic conditions.

3.7.2. Freeway Operations

Freeway Segments: The existing 2011 operations along the Route 460 and Business Route 29 freeway corridors were evaluated using both *HCS 2010* and the calibrated *VISSIM* model. The analysis results for both tools, including the average of ten (10) *VISSIM* runs, for the freeway segments within the Study Area are summarized in Table 3-4.

Table 3-4. 2011 Operational Performance of the Freeway Segments

Route	Location	Direction	HCS 2010 Results				VISSIM Results			
			Density (pc/mi/lane)		LOS		Density (veh/mi/lane)		LOS Range	
			AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Route 460	West of Candler Mountain Road	EB	14.2	10.4	B	A	14.0	10.3	B	B
		WB	10.1	17.2	A	B	9.3	15.2	A	B
Route 460	Candler Mountain Road to Campbell Avenue	EB	9.8	13.0	A	B	9.8	12.7	A	B
		WB	13.2	14.3	B	B	13.0	13.9	B	B
Route 460	East of Campbell Avenue	EB	8.2	12.6	A	B	8.2	12.3	A	B
		WB	12.6	11.7	B	B	12.0	11.0	B	B
Business Route 29	North of Odd Fellows Road	NB	17.3	14.3	B	B	15.9	13.9	B	B
		SB	17.4	14.2	B	B	15.0	14.6	B	B
Business Route 29	South of Odd Fellows Road	NB	18.6	13.8	C	B	15.7	14.0	B	B
		SB	16.5	15.5	B	B	15.2	15.0	B	B

The HCS analysis results in Table 3-4 indicate densities between eight (8) and seventeen (17) passenger cars per mile per lane along the Route 460 corridor, and densities between thirteen (13) and nineteen (19) along the Business Route 29 corridor. Overall, these densities indicate uncongested operations (LOS C or better) during the AM and PM peak periods along both freeway corridors.

Table 3-4 also includes a column titled “LOS Range.” This column was developed as a general comparison tool which relates the densities obtained from the *VISSIM* simulations (in vehicles per mile

per lane) to the density values presented in Exhibit 10-7 of the 2010 Highway Capacity Manual; these density values are the basis for the determination of the HCM Level of Service for a freeway segment. The HCS analysis results indicate that the freeway segments currently operate in the LOS A/B range along Route 460, and LOS B/C range along Business Route 29. The *VISSIM* analysis results indicate similar or slightly better operations, with the freeway segments currently operating in the LOS A/B range. For all segments, the *VISSIM* results are the same or within one LOS grade of those predicted by the HCS analysis.

Ramp Junctions: Capacity analyses were also conducted using both *HCS 2010* for the ramp junctions (merges / diverges) along Route 460 at Candler Mountain Road and Campbell Avenue and along Business Route 29 at Odd Fellows Road. The results of the ramp junction analysis for Route 460 are summarized in Table 3-5, and the results for Business Route 29 are summarized in Table 3-6.

Table 3-5. 2011 Operational Performance - Ramp Junctions (Route 460)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Candler Mountain Road Eastbound Off-Ramp	17.3	12.7	B	B	8.8	8.0	A	A
Candler Mountain Road Eastbound On-Ramp	11.9	15.2	B	B	9.5	12.2	A	B
Candler Mountain Road Westbound Off-Ramp	17.9	19.2	B	B	9.0	11.4	A	B
Candler Mountain Road Westbound On-Ramp	13.1	20.5	B	C	9.7	15.5	A	B
Campbell Avenue Eastbound Off-Ramp	13.4	17.2	B	B	8.2	11.0	A	B
Campbell Avenue Southbound to Eastbound On-Ramp	11.8	16.7	B	B	7.7	11.9	A	B
Campbell Avenue Northbound to Eastbound On-Ramp	11.7	16.4	B	B	8.1	12.4	A	B
Campbell Avenue Westbound Off-Ramp	15.8	14.7	B	B	10.0	10.0	B	B
Campbell Avenue Westbound On-Ramp	17.4	18.3	B	B	11.8	12.7	B	B

Table 3-6. 2011 Operational Performance - Ramp Junctions (Business Route 29)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Odd Fellows Road Northbound Off-Ramp	22.2	16.8	C	B	15.7	14.0	B	B
Odd Fellows Road Northbound On-Ramp	20.8	16.5	C	B	15.6	13.8	B	B
Odd Fellows Road Southbound Off-Ramp	19.9	16.3	B	B	13.5	13.4	B	B
Odd Fellows Road Southbound On-Ramp	20.6	20.5	C	C	16.0	15.7	B	B

The HCS analysis results indicate densities ranging from approximately twelve (12) to twenty-one (21) passenger cars per mile per lane within the various ramp merge and diverge areas along Route 460. Along Business Route 29, the analysis results indicate densities ranging from sixteen (16) and twenty-two (22) passenger cars per mile per lane. These densities indicate uncongested operations (LOS B / LOS C) during the AM and PM peak periods with the ramp junction areas along both freeways.

Along Northbound Clanders Mountain Road between Route 460 and Mayflower Drive there is an on-ramp from a shopping center and Liberty University. This ramp replaces the need for an eastbound left-turn lane at the Clanders Mountain Road / Mayflower Drive intersection. This ramp enters Clanders Mountain from the left side and has an acceleration lane of approximately 250 feet. This ramp junction was also analyzed using *HCS 2010* and results summarized in Table 3-7.

Table 3-7. 2011 Operational Performance - Ramp Junctions (Clanders Mountain Road)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (pc/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Clanders Mountain Shopping Center	21.7	17.4	C	B	23.1	15.5	C	B

Figure 7-1 summarizes the existing 2011 freeway segment and ramp junction traffic operations within the Study Area.

3.7.3. Intersection Analysis

Synchro and *SimTraffic* were utilized to assess the operations of four (4) key intersections along Clanders Mountain Road, Odd Fellows Road, and Campbell Avenue.

Along Clanders Mountain Road, the intersection analyzed is at Mayflower Drive. This signalized intersection is essentially a three-leg intersection with Clanders Mountain Road running north-south and Mayflower Drive running east-west from the eastern side of the intersection. The western leg of the intersection receives traffic from Clanders Mountain Road and Mayflower Drive to form Clanders

Mountain Drive heading toward Liberty University; however, there is no approaching traffic from the west-leg of the intersection.

Odd Fellows Road and Mayflower Drive is a signalized intersection. For the purposes of this analysis, Odd Fellows Road is assumed to run north-south and Mayflower Drive is assumed to run east-west.

The other two intersections analyzed within the Study Area are along Campbell Avenue at the Route 460 ramp terminals. For these intersections, Campbell Avenue is assumed to run north-south, with the Route 460 ramps running east-west. The eastbound ramp terminal is unsignalized; the Route 460 eastbound off-ramp left-turn movement is stop-controlled and Campbell Avenue is uncontrolled (free-flow). The westbound Route 460 ramp terminal is a signalized intersection with a free-flowing right turn from the westbound off-ramp to northbound Campbell Avenue.

Levels of Service and delay are reported from the HCM Signals and Unsignalized Reports within *Synchro*. The maximum queues are reported from an average of five (5) simulation runs in *SimTraffic*. Table 3-8 summarizes the average AM and PM peak hour delay and maximum queues for each lane group at all Study Area intersections.

Table 3-8. Existing (2011) Intersection Operations

Intersection	Movement	AM			PM		
		Delay (sec/veh)	Maximum Queue (ft)	LOS	Delay (sec/veh)	Maximum Queue (ft)	LOS
Candlers Mountain Road at Mayflower Drive	NB Left	80.7	285	F	28.4	270	C
	NB Thru	17.0	595	B	18.6	420	B
	NB Right	11.1	195	B	10.6	80	B
	SB Left	22.0	250	C	15.9	260	B
	SB Thru	63.4	635*	E	30.0	635*	C
	SB Right						
	WB Left	68.5	620	E	195.0	940	F
	WB Thru						
	WB Right	39.3	280	D	42.5	280	D
ALL	41.7	-	D	42.5	-	D	
Odd Fellows Road at Mayflower Drive	EB Left	16.9	150	B	16.9	150	B
	EB Thru	14.5	515	B	14.2	160	B
	EB Right						
	WB Left	30.3	55	C	29.8	15	C
	WB Thru	33.0	155	C	33.0	125	C
	WB Right						
	NB Left	39.1	100	D	32.0	65	C
	NB Thru	39.2	135	D	33.7	120	C
	NB Right						
	SB Left	33.4	415	C	33.7	220	C
	SB Thru						
SB Right							
ALL	27.6	-	C	26.9	-	C	
Campbell Avenue at Route 460 Eastbound Off-Ramp	EB Left	32.8	440	D	49.1	270	E
	EB Right						
	NB Thru	Free-Flow			Free-Flow		
	SB Thru	Free-Flow			Free-Flow		
	ALL	-	-	-	-	-	-
Campbell Avenue at Route 460 Westbound Ramp Terminals	WB Left	40.0	105	D	66.8	195	E
	WB Right	58.5		E	54.0	-	D
	NB Left	6.9	125	A	9.7	95	A
	NB Thru	6.1	95	A	3.3	85	A
	SB Thru	13.4	185	B	12.0	390	B
	SB Right						
	ALL	20.1	-	C	15.9	-	B

*Queue exceeds available storage to upstream signalized intersection at Murray Place.

The results in Table 3-8 indicate that two of these four (4) intersections operate within acceptable levels (LOS C or better) during the AM peak hour; however, the Candlers Mountain Road / Mayflower Drive and the stop-controlled left-turn movement from the eastbound Route 460 left-turn movement to northbound Campbell Avenue both currently operate at LOS D. During the PM peak hour, two of the four intersections operate at LOS C or better. The unsignalized left-turn from the Route 460 eastbound

off-ramp at Campbell Avenue currently operates at LOS E, and the Candler's Mountain Road and Mayflower Drive intersection currently operates at LOS D during the PM peak hour.

3.8. Existing Safety Conditions

In addition to the operational analyses summarized in Section 3.7, a detailed analysis of the existing safety performance within the Study Area was conducted. A three-year crash history was provided by the City of Lynchburg for Candler's Mountain Road, Odd Fellows Road and Mayflower Drive. A two-year crash history was provided by VDOT for Route 460. The historical crash data was reviewed to identify crash trends and locations with a high incidence of crashes. Crashes were summarized by roadway facility. Along Route 460, because the total number of crashes within the Study Area was less than twenty (20) it was not necessary to reduce the corridor to different segments to evaluate the crash trends.

3.8.1. Crash Summary and History

During the years of 2007 and 2008, a total of 15 crashes were reported along the study segment of Route 460. A total of 256 crashes occurred along the study segment of Candler's Mountain Road between November 1, 2008 and October 31, 2011. During the same period, 15 crashes occurred along the study segment of Odd Fellows Road. A total of 19 crashes occurred along the segment of Mayflower Drive from Candler's Mountain Road to Odd Fellows Road between May 2008 and October 2011. Table 3-9 summarizes the crashes that occurred along Route 460; Table 3-10 summarizes the crash data along Candler's Mountain Road; Table 3-11 summarizes the results along Odd Fellows Road; and Table 3-12 summarizes the results along Mayflower Drive.

Table 3-9. 2007-2008 Crash History – Route 460

		Crash Type					Severity			Pavement Condition			Light Condition	
Route 460														
Year	Total	RE	SS	FO	O	F	Inj	PDO	D	W	O	Daylight	Dark	
2007	8	3	1	1	3	0	5	3	7	0	1	4	4	
2008	7	3	0	4	0	0	5	2	4	2	1	4	3	
	15	6	1	5	3	0	10	5	11	2	2	8	7	

Key: RE-Rear End SS – Sideswipe (same direction) FO-Fixed Object O-Other F-Fatal Inj- Injury PDO–Property Damage Only D-Dry W-Wet

Table 3-10. 2008-2011 Crash History – Candler's Mountain Road

		Crash Type				Severity			Pavement Condition				Light Condition	
Candler's Mountain Road														
Year	Total	RE	SS	A	O	F	Inj	PDO	D	W	I	O	Daylight	Dark
2008-2009	86	55	5	22	4	0	15	71	65	16	5	0	61	25
2009-2010	88	51	5	27	5	0	12	76	71	16	0	1	72	16
2010-2011	82	46	5	30	1	0	9	73	76	6	0	0	62	20
	256	152	15	79	10	0	36	220	212	38	5	1	195	61

Key: RE-Rear End SS – Sideswipe (same direction) A-Angle O-Other F-Fatal Inj- Injury PDO–Property Damage Only D-Dry W-Wet I-Icy

Table 3-11. 2008-2011 Crash History – Odd Fellows Road

		Crash Type				Severity			Pavement Condition			Light Condition	
Odd Fellows Road													
Year	Total	RE	SS	A	O	F	Inj	PDO	D	W	O	Daylight	Dark
2008-2009	0	0	0	0	0	0	0	0	0	0	0	0	0
2009-2010	6	1	0	4	1	0	3	3	6	0	0	4	2
2010-2011	9	3	0	5	1	1	1	7	8	1	0	6	3
	15	4	0	9	2	1	4	10	14	1	0	10	5

Key: RE-Rear End SS – Sideswipe (same direction) A-Angle O-Other F-Fatal Inj- Injury PDO–Property Damage Only D-Dry W-Wet I-Icy

Table 3-12. 2008-2011 Crash History – Mayflower Drive

		Crash Type				Severity			Pavement Condition			Light Condition	
Mayflower Drive													
Year	Total	RE	FO	A	O	F	Inj	PDO	D	W	O	Daylight	Dark
2008	7	2	2	1	2	0	2	5	6	1	0	7	0
2009	5	4	0	1	0	0	0	5	5	0	0	5	0
2010	5	2	1	2	0	0	3	2	3	0	2	5	0
2011	2	1	1	0	0	0	0	2	1	1	0	1	1
	19	9	4	4	2	0	5	14	15	2	2	18	1

Key: RE-Rear End FO-Fixed Object A-Angle O-Other F-Fatal Inj- Injury PDO–Property Damage Only D-Dry W-Wet I-Icy

The crashes along Route 460 were also summarized by month of year, time-of-day, and day of week. These results are summarized in Table 3-13.

Table 3-13. Route 460 Summary of Crashes

Route 460 from west of Candler Mountain Road to east of Campbell Avenue		Year		2 Year Total Crashes	Mean Crashes Per Year	Percentage
		2007	2008			
CRASH TYPE	Rear End	3	3	6	3.00	40.00%
	Sideswipe	1	0	1	0.50	6.67%
	Fixed Object	1	4	5	2.50	33.33%
	Wildlife	2	0	2	1.00	13.33%
	Other	1	0	1	0.50	6.67%
	Total Crashes	8	7	15	7.50	100.00%
SEVERITY	PDO Crashes	5	5	10	5.00	66.67%
	Injury Crashes	3	2	5	2.50	33.33%
LIGHTING CONDITIONS	Daylight	4	4	8	4.00	53.33%
	Dark	4	3	7	3.50	46.67%
SURFACE CONDITIONS	Dry	7	4	11	5.50	73.33%
	Wet	0	2	2	1.00	13.33%
	Snow	0	1	1	0.50	6.67%
	Icy	1	0	1	0.50	6.67%
MONTH OF YEAR	January	0	1	1	0.50	6.67%
	February	1	0	1	0.50	6.67%
	March	1	0	1	0.50	6.67%
	April	0	2	2	1.00	13.33%
	May	1	0	1	0.50	6.67%
	June	0	0	0	0.00	0.00%
	July	0	1	1	0.50	6.67%
	August	0	0	0	0.00	0.00%
	September	0	0	0	0.00	0.00%
	October	3	1	4	2.00	26.67%
	November	0	1	1	0.50	6.67%
	December	2	1	3	1.50	20.00%
DAY OF WEEK	Sunday	1	1	2	1.00	13.33%
	Monday	2	0	2	1.00	13.33%
	Tuesday	3	1	4	2.00	26.67%
	Wednesday	1	3	4	2.00	26.67%
	Thursday	0	1	1	0.50	6.67%
	Friday	1	0	1	0.50	6.67%
	Saturday	0	1	1	0.50	6.67%
HOUR OF DAY	00:00-06:00	1	0	1	0.50	6.67%
	06:00-09:00	2	3	5	2.50	33.33%
	09:00-11:00	0	0	0	0.00	0.00%
	11:00-13:00	1	1	2	1.00	13.33%
	13:00-15:00	0	1	1	0.50	6.67%
	15:00-18:00	1	1	2	1.00	13.33%
	18:00-24:00	3	1	4	2.00	26.67%

3.8.2. Crash Rates

The overall crash rate for each corridor was compared to the statewide average rates by segment type as shown in Table 3-14. Additionally a comparison of the injury crash rate for these segments to the statewide average injury crash rates is summarized in Table 3-15.

Table 3-14. Overall Crash Rate Comparison

Road Segment	Total Crashes	Segment Crash Rate	Statewide Average Rate	Percent Difference
Candlers Mountain Road	256	793 per 100 MVMT	98 per 100 MVMT	+709%
Odd Fellows Road	15	428 per 100 MVMT	126 per 100 MVMT	+240%
Route 460	15	19 per 100 MVMT	51 per 100 MVMT	-63%
Mayflower Drive	19	151 per 100 MVMT	126 per 100 MVMT	+19%

Notes: Candlers Mountain Road compared to Four-Lane Roads with Divided-Part Control, Odd Fellows Road compared to Two-Lane, Two-Way, Non-Divided Roads, and Route 460 was compared to Four-Lane, Divided-Full Control Roads. These average rates are from VDOT's 2000 to 2007 Crash Summary Statistics on Interstate and Primary Routes.

Table 3-15. Injury Crash Rate Comparison

Road Segment	Total Injury Crashes	Segment Injury Crash Rate	Statewide Average Rate	Percent Difference
Candlers Mountain Road	36	112 per 100 MVMT	53 per 100 MVMT	+111%
Odd Fellows Road	4	12 per 100 MVMT	77 per 100 MVMT	-84%
Route 460	10	31 per 100 MVMT	26 per 100 MVMT	+19%
Mayflower Drive	5	42 per 100 MVMT	77 per 100 MVMT	-45%

Notes: Candlers Mountain Road compared to Four-Lane Roads with Divided-Part Control, Odd Fellows Road compared to Two-Lane, Two-Way, Non-Divided Roads, and Route 460 was compared to Four-Lane, Divided-Full Control Roads. These average rates are from VDOT's 2000 to 2007 Crash Summary Statistics on Interstate and Primary Routes.

The overall crash rate along Route 460 is approximately 63 percent less than the statewide average for similar facilities. However, potentially due to the high speeds along the corridor, the injury crash rate exceeds that of similar facilities around the state by approximately 19 percent. A comparison of the total and injury crash rates along Candlers Mountain Road indicate both rates exceed those along similar facilities across Virginia. Total crash rates along Odd Fellows Road are higher than the statewide average, but injury crash rates are lower. There was, however, one fatal crash reported along Odd Fellows Road during the study period (see Section 3.8.5 for additional detail on crash severity). Along Mayflower Drive, the total crash rate is approximately 19 percent higher than the statewide average for similar facilities during the study period, but the injury crash rate is 45 percent lower.

3.8.3. Crash Locations

Along the Route 460 corridor, crashes by location and type were plotted on an aerial photograph to identify potential crash clusters within the Study Area. Figure 3-2 is a graphic representation of the crash locations along Route 460.



Legend

-  FO – Fixed Object
-  RE – Rear End
-  SS – Sideswipe
-  Animal
-  Other

**Figure 3-2 – Route 460 Crash Location and Types
(2007-2008)**

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Along Route 460, there were no apparent crash clusters or high crash locations. The crashes were distributed throughout the study segment of the corridor. Of note, there were six (6) crashes along eastbound Route 460 between the on-ramp from Candler's Mountain Road and the proposed location of the Odd Fellows Road interchange (segment length of approximately 1-mile). Three (3) of these crashes were rear-end crashes, while another was a sideswipe collision. Potential contributing factors identified from the police reports included drivers failing to maintain vehicle control, drivers following too closely, and improper lane changes.

Along Candler's Mountain Road, the crash locations are mostly contained in and around the intersections of Murray Place, Mayflower Drive, Seminole Avenue/Business Route 29 Southbound Off-Ramp, and the Business Route 29 interchange. Among these locations, the Murray Place intersection (also the main entrance for River Ridge Mall) contained 118 of the 256 crashes during the three-year period or forty-six (46) percent of the crashes along the study corridor within the study period. The second most prevalent location along Candler's Mountain Road was the Mayflower Drive intersection containing approximately 27 percent of the crashes (68 out of 256) in the three-year study period. The predominant crash type at both locations was rear end collisions.

Along Odd Fellows Road, the crash locations are also centered near the intersections. Thirteen (13) of the fifteen (15) crashes along this corridor occurred in or around three intersections (Murray Place, Mayflower Drive, and Albert Lankford Drive) with the remaining two (2) occurring within the Business Route 29 interchange. The predominant crash location along this corridor is at the Albert Lankford Drive intersection, where approximately 47 percent (7 out of 15) of all crashes occurred during the three-year study period. The predominant crash type at this location was angle crashes involving left-turning vehicles. These angle collisions accounted for approximately 86 percent (6 out of 7) of the crashes at reported at this intersection.

Along Mayflower Drive, crashes were typically reported near the intersections and driveways along the corridor. More than half (10 out of 19) crashes were related to turning movements or vehicles waiting to make a turning movement at an intersection or driveway along the corridor. The intersections of Young Place (5 out of 19) and Candler's Mountain Road (7 out of 19) are the two most predominant crash locations on the corridor.

3.8.4. Crash Type

Along Route 460, the crash types were fairly well distributed. Rear end collisions represent the most common type, accounting for 40 percent (6 out of 15) of the crashes. Fixed object collisions involving an off-road object were the second most common type and represented approximately 33 percent (5 out of 15) of the total crashes. Several of the fixed object collisions occurred during wet or snowy conditions, which may have contributed to drivers losing control of their vehicles and striking objects which included guardrails and culverts.

During the three-year study period, the most common crash type along Candler's Mountain Road was rear end collisions, with this crash type accounting for approximately 60 percent (152 out of 256) of all reported crashes during the study period. The second most common crash type was angle crashes accounting for approximately 31 percent (79 out of 256). The rear-end collisions were associated with rapid speed changes due to the queues from the signalized intersections along the corridor, driver inattention, and following too closely.

Along the Odd Fellows Road corridor, the predominant crash type was angle collisions involving left-turning vehicles; these crashes accounted for approximately 53 percent (8 out of 15) of the reported crashes. Six of these crashes occurred in and around the Albert Lankford Drive intersection. A potential contributing factor for the angle collisions were drivers failing to yield the right-of-way. Rear end collisions represented the second most common crash type along this corridor, accounting for approximately 27 percent (4 out of 15) of the crashes.

Along Mayflower Drive, the predominant crash type was rear end collisions which account for approximately 47 percent (9 out of 19) of the reported crashes. Many of these crashes were reported as collisions near intersections or driveways and occurred while vehicles were getting ready to turn or waiting to make a left-turning movement. Fixed-object and angle collisions were tied for the next most predominant type with each accounting for approximately 21 percent (4 out of 19) each. The remaining collisions were recorded as Other and included an improperly loaded truck which buckled while travelling along Mayflower Drive and damaged the roadway surface.

3.8.5. Crash Severity

During the study period, along Route 460, approximately 66 percent (10 out of 15) of the total crashes resulted in injury. One fatality was reported along Route 460, but that the fatality was due a heart attack that occurred while a motorist was driving and the heart attack was identified as the cause of death. The remaining third (5 out of 15) of the crashes resulted in Property Damage Only. Rear end crashes and fixed object crashes involving off-road objects were the two predominant injury crash types representing 50 percent (5 out of 10), and 30 percent (3 out of 10) of the total injury crashes, respectively.

During the three-year study period, along Candler's Mountain Road, approximately 15 percent (36 out of 256) of the crashes resulted in injury. No fatal crashes were reported. The remaining 85 percent (220 out of 256) of the crashes resulted in Property Damage Only. The predominant injury crash type along this corridor was rear end collisions.

During the three-year period, along Odd Fellows Road, approximately one-third (5 out of 15) of the total crashes resulted in injury or fatality, with the remaining two-thirds (10 out of 15) resulting in Property Damage Only. The most common injury crash type along this corridor was an angle crash involving left turning vehicles. The one fatality along the corridor occurred as a result of a crash listed as "Other". News reports of this crash noted that the driver was traveling at a high rate of speed on a motorcycle when they lost control and ran off the road.

No fatalities were reported along Mayflower Drive during the study period. Approximately 26 percent (5 out of 19) of the total crashes reported resulted in injury with the remaining 74 percent (14 out of 19) being classified as Property Damage Only.

3.9. Existing Environmental Constraints

The study area is bounded by the urbanized area of the City of Lynchburg to the north and east, Liberty University to the west and Candler's Mountain to the south. The area to the north and east is fairly developed with industrial uses and to the west is built up with the university. To the south, the northern face of Candler's Mountain and associated steep slopes discourage development. No critical

environmental constraints have been identified to date. Additional data regarding the environmental studies for this project that are required by the National Environmental Policy Act (NEPA) can be found in Chapter 9 of this report.

4. ALTERNATIVES CONSIDERED

This Chapter summarizes the Alternatives considered for construction of the Route 460 / Odd Fellows Road interchange. The proposed interchange at Route 460 and Odd Fellows Road is primarily being driven by a need to address existing and future safety and operational concerns within the Study Area and also to provide improved access for businesses located in the industrial park along Odd Fellows Road and Mayflower Drive. A No Build Alternative was included in this evaluation. Multiple design concepts for the Build Alternative were considered as part of this study. Each design concept included construction of an interchange along Route 460 at Odd Fellows Road; it was assumed that the design on the north side of Route 460 (westbound on and off-ramps) would be the same across all alternatives.

4.1. No Build Alternative

The No Build Alternative would maintain existing access along Route 460 with the directional T-interchange at Candler's Mountain Road and the partial-cloverleaf interchange at Campbell Avenue. The existing alignments for all facilities within the Study Area would remain unchanged. The No Build Alternative would not satisfy the stated project purpose and need to provide safety, operational and access improvements within the Study Area while supporting future economic development and accommodating future traffic growth. The No Build Alternative would not provide improved access to the industrial areas including the First Lynchburg Park Industrial Park or to the undeveloped land between Route 460 and the north slope of Candler's Mountain.

For the purpose of comparison to the Build Alternative, operational analyses were conducted for the No Build Alternative for the Opening and Design Years; the results of those analyses are detailed in Sections 7.3.1 and 7.3.2.

4.2. Transportation System Management Alternatives

Transportation System Management (TSM) typically involves the identification of minor enhancements to the existing transportation system that could alleviate localized operational deficiencies. For freeway corridors, TSM strategies could include traffic surveillance and monitoring equipment, incident management programs, High-Occupancy Vehicle (HOV) lanes, ramp metering, or signing and pavement marking improvements. Corridor and system-wide TSM strategies may include Intelligent Transportation Systems (ITS), improved mass transit service, and pedestrian / multi-modal facilities. Along arterials, TSM strategies could include signal timing optimization, additional turning lanes, and / or modifications to lane usage.

TSM measures alone will not fully address the purpose and need of this project. TSM measures may provide enhanced safety and operations along the existing facilities within the Study Area, including Candler's Mountain Road and Mayflower Drive. However, TSM measures would not provide additional access between Route 460 and the industrial employment area along Odd Fellows Road and would not reduce the reliance on Candler's Mountain Road as the primary access for a mix of retail, educational, and industrial uses. The proposed Build Alternative does not preclude the adoption of future TSM strategies within the Study Area, which may include enhanced ITS systems, improved regional transit service, and/or multi-modal enhancements. Therefore, the proposed Build Alternative satisfies the intent of FHWA's Policy Point #2.

4.3. Build Alternatives

A number of potential Build Alternatives were evaluated as part of this study. Each of these Build Alternatives was intended to address existing and future safety concerns, as well as accommodate future traffic growth in the Study Area, and enhance access between the City of Lynchburg and Route 460. An initial geometric and traffic feasibility analysis was conducted which resulted in the identification of four (4) potential designs for the Build Alternative:

- Alternative 1 – No Build
- Alternative 2 – Odd Fellows Road curved bridge over Route 460 and a partial-cloverleaf interchange with diamond style ramps on the northern side of the interchange, and a loop/diamond ramp combination on the west side of Odd Fellows Road to service the eastbound Route 460 movements.
- Alternative 3 – Simple Diamond Interchange with stub-out to the South and a roundabout at the future Top Ridge Connector; 600-foot spacing to the roundabout to the south.
- Alternative 4 – Partial-Cloverleaf Interchange with diamond style ramps on the northern side of the interchange, and a loop/diamond ramp combination on the east side of Odd Fellows Road to service the eastbound Route 460 movements.
- Alternative 5 - Odd Fellows Road curved bridge over Route 460 and a diamond interchange.

4.4. Selection of Preferred Build Alternative

Preliminary layouts were developed for each Build Alternative. As a result of a May 2012 meeting between VDOT and the City of Lynchburg, Alternative 4 was eliminated from further consideration due to the potential impacts to Candler's Mountain required to accommodate the eastbound Route 460 loop-type off-ramp and a relocated Top Ridge Road. The remaining alternatives were evaluated further to identify the preferred design concept. The following parameters were used to evaluate the remaining alternatives and select the Preferred Alternative:

- Traffic Operations
- Safety of Proposed Design
- Constructability and Cost
- Improved Access

Traffic Operations:

For the remaining Alternatives (2, 3, and 5), the operations of the proposed ramp junctions along Route 460 and the ramp terminal intersections along Odd Fellows Road were evaluated to determine if any Alternatives would not provide acceptable operations in the Design Year. The ramp junction analysis, conducted using *HCS 2010* is summarized in Table 4-1.

Table 4-1. Summary of Ramp Junction Analyses – Design Year 2035

Intersection	Alternative 2 Partial Cloverleaf				Alternatives 3 and 5 Diamond Configurations			
	LOS		Density (pc/mi/ln)		LOS		Density (pc/mi/ln)	
	AM	PM	AM	PM	AM	PM	AM	PM
Eastbound Route 460 Off-Ramp	C	C	20	22	C	C	20	22
Eastbound Route 460 On-Ramp	B	C	18	21	C	C	20	24
Westbound Route 460 Off-Ramp	C	C	25	21	C	C	25	21
Westbound Route 460 On-Ramp	C	C	27	26	C	C	27	26

The ramp terminal intersection analyses for the Build Alternatives were conducted using *SimTraffic*. Levels of service, delay, and maximum queues were reported for the controlled movements based on the average of five (5) simulation runs with different random number seeds. A preliminary signal warrant analysis indicated that neither of the volume-based traffic signal warrants (Warrant 1 – 8 Hour Vehicular Volume or Warrant 2 – 4 Hour Vehicular Volume) identified in the Manual on Uniform Traffic Control Devices (MUTCD) would likely be satisfied for either of the ramp terminal intersections by Design Year 2035. For this IJR, it was assumed that the ramp terminal intersections would be unsignalized, with stop-control along the off-ramps, in the Design Year. The ramp terminal intersection analysis is summarized in Table 4-2.

Table 4-2. Summary of Ramp Terminal Intersection Operations – Design Year 2035

Intersection	Alternative 2 Partial Cloverleaf						Alternatives 3 and 5 Diamond Configuration					
	LOS		Delay (sec/veh)		Max Queue		LOS		Delay (sec/veh)		Max Queue	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Eastbound Route 460 Ramps at Odd Fellows Road												
EB Route 460 Off-Ramp Left	C	C	27	23	270	180	B	B	17	15	195	145
EB Route 460 Off-Ramp Right	A	A	4	6	65	110	A	A	5	6	75	130
SB Odd Fellows Left	n/a						A	A	3	4	55	75
NB Odd Fellows Left	A	A	5	6	80	105	n/a					
Westbound Route 460 Ramps at Odd Fellows Road												
WB Route 460 Off-Ramp Left	B	B	15	14	145	180	B	B	16	14	180	160
WB Route 460 Off-Ramp Right	A	A	6	4	115	90	A	A	6	4	115	75
NB Odd Fellows Left	A	A	3	3	65	75	A	A	3	3	55	65

The results of the ramp junction and ramp terminal intersection analyses summarized in Tables 4-1 Table 4-2, respectively, indicated that all three (3) of the remaining build alternatives would result in acceptable operations (LOS C or better) at all locations at the proposed interchange. The diamond alternatives (Alternatives 3 and 5) resulted in lower delays and shorter queues at the eastbound ramp terminal intersection than the partial cloverleaf alternative (Alternative 2). However, both options would satisfy the applicable FHWA Level of Service design criteria for National Highway System (NHS) routes.

Safety: All preliminary layouts were designed in accordance with the Design Criteria established in Chapter 5 of this IJR and in compliance with the applicable VDOT and AASHTO design guidelines. Therefore, each alternative would be expected to meet or exceed current geometric and safety standards. In terms of safety, one difference identified between the remaining build alternatives was the loop-type on-ramp from Odd Fellows Road to eastbound Route 460 for the partial cloverleaf design (Alternative 2). This loop-ramp would result in slower on-ramp speeds and require additional acceleration length along eastbound Route 460. Loop-type on and off-ramps are typically associated with a higher frequency of fixed-object collisions due to vehicles failing to properly negotiate the tight curvature and departing the roadway. The skewed bridge and location of the eastbound ramp terminal intersection within a curve along Odd Fellows Road were also identified as potential safety concerns with Alternatives 2 and 5.

Constructability and Cost: The primary difference between the three (3) build alternatives in terms of cost and constructability was the skewed bridge on a curve included in the design for Alternatives 2 and 5. It was anticipated that this type of bridge structure would be difficult to construct and would

substantially increase the cost of the project relative to Alternative 3 which includes a more perpendicular bridge crossing of Route 460.

Improved Access: Each of the proposed Build alternatives would satisfy this component of the project purpose and need, which is also closely linked to future economic development. Each alternative would provide a new interchange along Route 460 and include ramps for all movements. Each Build alternative would provide enhanced access to the industrial areas north of Route 460 and facilitate future development south of Route 460. No notable differences in terms of access were identified.

Table 4-3 presents an Alternative matrix which compares the three (3) Build Alternatives in terms of these three (3) evaluation criteria. Figures depicting each of these alternatives can be found in Figures 4-1 through 4-4.

Table 4-3. Build Alternative Evaluation Matrix

	Traffic Operations	Safety	Cost & Constructability	Access
Alternative 1 – No Build	Does not meet purpose and need.			
Alternative 2 - Partial Cloverleaf	Ramps: LOS C Intersections: LOS C	Loop-type ramp not preferred to diamond type-ramp.	Concerns with skewed bridge.	Improved access
Alternative 3 – Standard Diamond	Ramps: LOS C Intersections: LOS B	Diamond ramps with 90-degree intersections	Typical bridge crossing.	Improved access
Alternative 5 – Skewed Diamond	Ramps: LOS C Intersections: LOS B	Diamond ramps with skewed intersections.	Concerns with skewed bridge	Improved access
Best Performing Alternative(s)	Alternatives 3 & 5	Alternative 3	Alternative 3	Alternative 2, 3, and 5

Alternative 3 was rated as a “Best Performing Alternative” for each of the four Evaluation Criteria, as noted in Table 4-3. Alternative 5 was rated as a “Best Performing Alternative” for two of the four evaluation criteria. Alternative 2 was rated a “Best Performing Alternative” for one of the four evaluation criteria. Based on these findings, Alternative 3 was identified by the project team as the overall “Best Performing Alternative.”

During another meeting between VDOT, the City of Lynchburg, and Campbell County, the advantages and disadvantages of the various remaining Build Alternatives were reviewed. At that meeting, Alternatives 2 and 5 were eliminated, primarily because of the cost and constructability concerns associated with the skewed bridge crossing of Route 460. At this point **Alternative 3 (simple diamond configuration) was identified as the Preferred Build Alternative.**

4.5. Refinement of the Preferred Build Alternative

After a more detailed study of Alternative 3, it was found that the alternative as originally developed needed to be refined. These refinements were necessitated by the impacts of the proposed 600-foot southern extension of Odd Fellows Road, which would extend into the north slope of Candler's Mountain. The original version of Alternative 3 would have required extensive excavation (approximately 325,000 cubic yards) and a cut of 280 feet in order to construct the proposed roundabout at the southern terminus of Odd Fellows Road. This was anticipated to result in an additional cost of \$1.14 million. Additional excavation of the hillside would also ultimately be required for construction of the connector roads intersecting Odd Fellows Road at the proposed roundabout. A design option to reduce the amount of excavation by providing a retaining wall at the south end of the project was also considered. The initial design indicated that a retaining wall 100 feet tall would be required, with an anticipated additional cost of \$3.28 million. Both the earthwork and retaining wall options would have been cost prohibitive and undesirable from an aesthetics standpoint due to the impacts to Candler's Mountain. As a result of this detailed study, several variations of the Preferred Build Alternative were then investigated:

Option 1 – Shorten the Odd Fellows Road extension from 600' to 360' and terminate with a roundabout. This option would reduce the hillside excavation, reduce the construction costs, and would provide an aesthetically pleasing view. The eastbound Route 460 ramps (Ramps A and B) were moved closer to Route 460 to maximize the distance that the roundabout at the southern terminus of the extension of Odd Fellows Road could be moved north from the steep hillside.

Figure 4-1. Alternative 2 – Partial-Cloverleaf

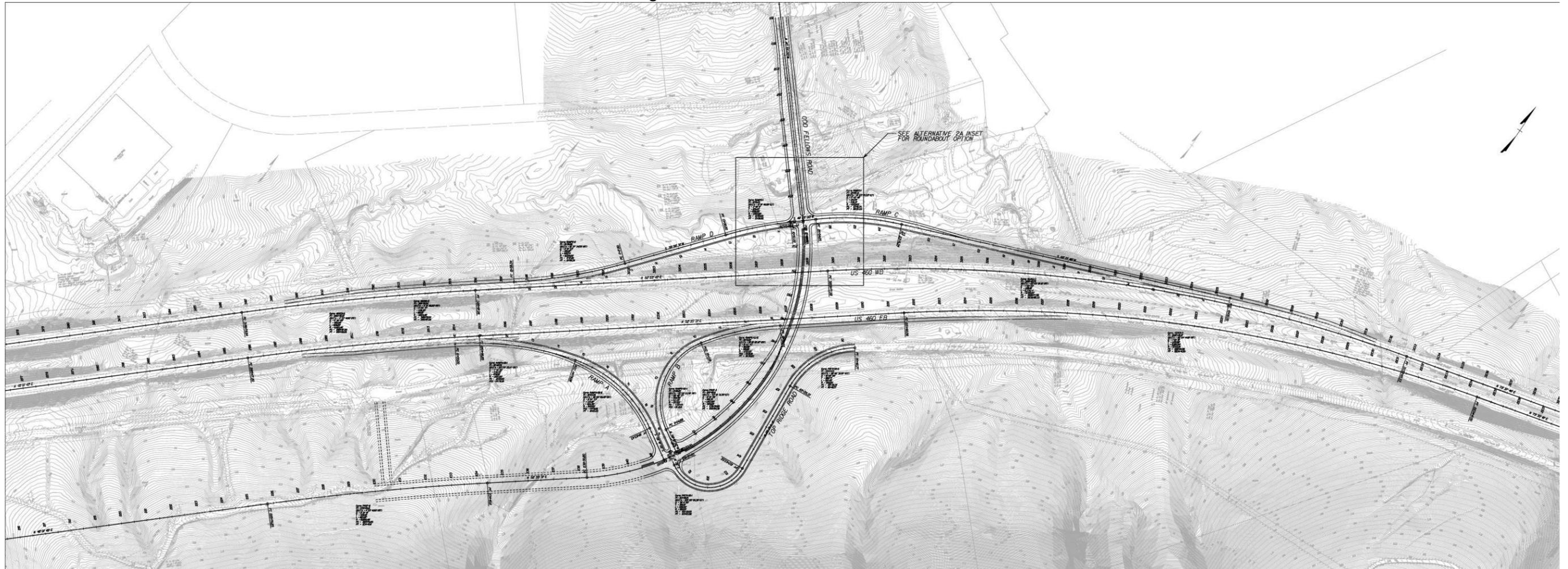


Figure 4-2. Alternative 3 – Standard Diamond (Preferred)

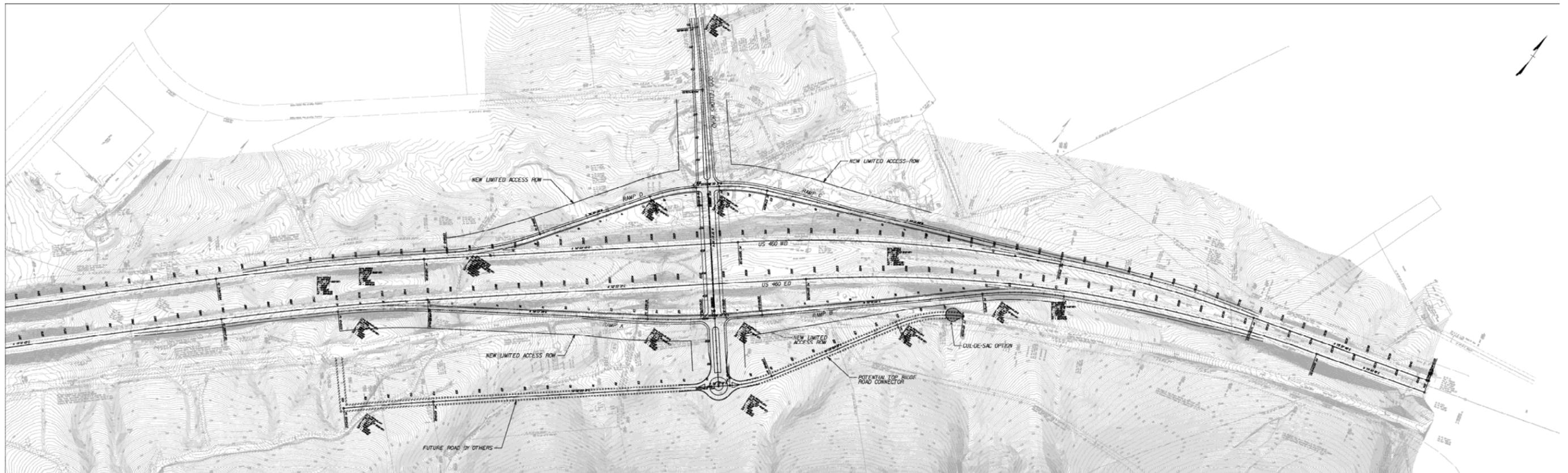
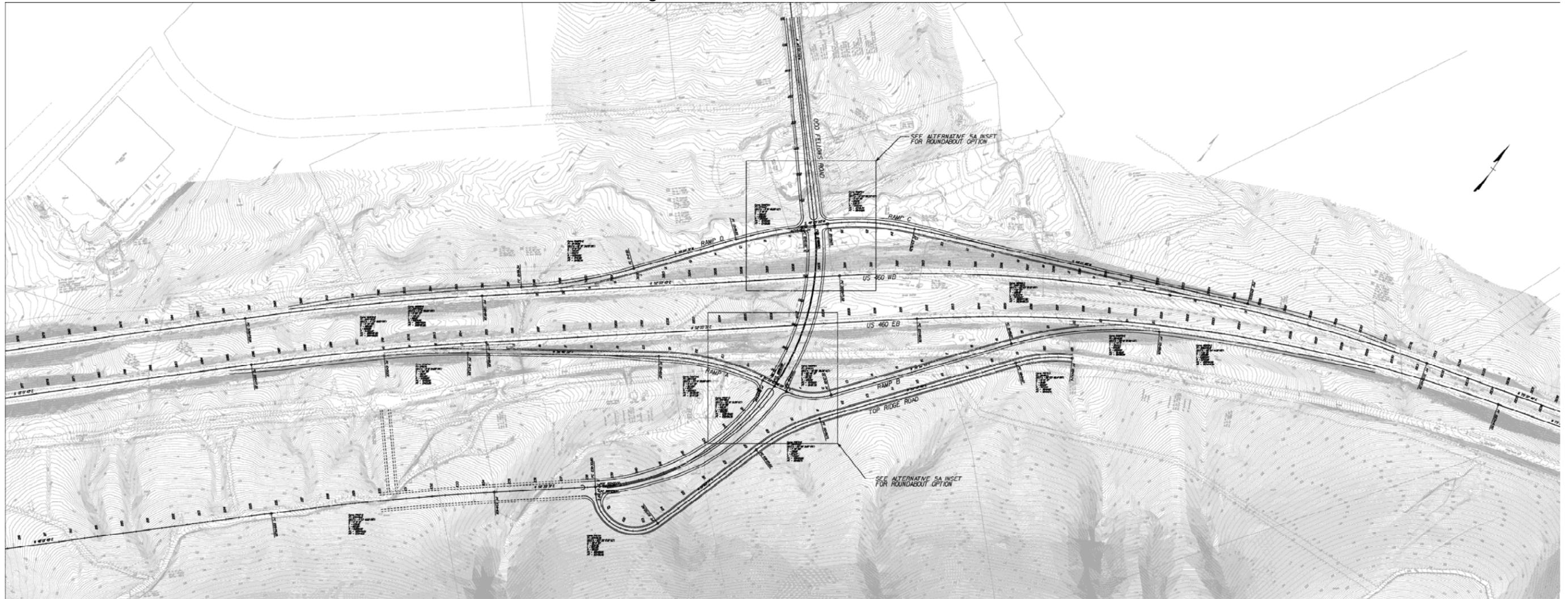


Figure 4-3. Alternative 4 – Partial-Cloverleaf (East)



Figure 4-4. Alternative 5 – Skewed Diamond



Option 2 – Similar to Option 1, Odd Fellows Road would be skewed across Route 460 and then curved to the west to make better use of the existing contours south of Route 460. The extension would still terminate with a roundabout. This option provides for approximately 500' between the proposed roundabout and eastbound ramp terminal intersection. This option would reduce the hillside excavation, reduce the construction costs, and would provide an aesthetic pleasing view. The bridge over Route 460 would need to be longer due to the proposed skew. The eastbound Route 460 ramps (Ramps A and B) were moved closer to Route 460 to maximize the distance that the roundabout at the southern terminus of the extension of Odd Fellows Road could be moved north from the steep hillside.

Option 3 – Provide a five-legged roundabout at the intersection of the eastbound Route 460 ramps (Ramps A/B) with Odd Fellows Road that includes stub outs for a future connection to Top Ridge Road and a future roadway connection to the Liberty University property. This option would reduce the footprint of the project, eliminate almost all excavation of the hillside but would put all ramp and frontage road traffic into one intersection. This option would not provide the minimum 300' distance to meet the limited access right-of-way requirements, but the limited access line could be extended 300' along each leg of the intersecting roadways.

Selection of Refined Design Alternative

A thorough comparison was conducted for these three (3) potential refinements to the Preferred Alternative (Alternative 3). Overall, Alternative 3 - Option 1 was determined to best meet the requirements and goals of the project. The estimated construction cost for this option was only slightly more expensive than Option 3. With Option 1, the Odd Fellows Road alignment is virtually straight across Route 460 and terminates with a roundabout for future connection to Top Ridge Road. With this option, the connections to Top Ridge Road and the Liberty University property will tie into the roundabout outside of the interchange. The 300-foot requirement for limited access control outside of the interchange can be achieved. The future connections to Top Ridge Road and the Liberty University property would intersect Odd Fellows Road at 90-degrees and enable the construction of a smaller diameter roundabout at the southern terminus of the project. A detailed summary of the Opening Year and Design Year operations of the Preferred Build Alternative (Alternative 3 – Option 1) can be found in Chapter 7 of this IJR.

The reasons for dropping Options 2 and 3 are summarized below.

Option 2 was not selected for the following reasons:

- It has a less desirable horizontal and vertical alignment.
- It has the highest construction costs.
- The Option 2 alignment is on a skew across Route 460 and has superelevation transitions that would extend back onto the bridge as well as into the intersection of the Route 460 eastbound ramps and Odd Fellows Road.
- It would require a steeper grade (6%) on Odd Fellows Road and would require a higher profile grade on the eastbound Route 460 ramps (Ramps A and B).
- While this alignment makes better use of the existing contours of the mountain, it would require a longer future connection to Top Ridge Road along the side of the mountain.
- The skew angle into the proposed roundabout at the southern terminus of Odd Fellows Road would not be ideal and would require a larger radius roundabout to provide the required turning movements and splitter islands.

Option 3 was not selected for the following reasons:

- While this option is less expensive than Option 1, there is only a minimal difference in costs (\$200,000).
- The roundabout design mixes all traffic from the two connector roads along with the eastbound Route 460 ramps into one location. This will require a larger diameter roundabout to address the skewed entrances, turning movements, trucks and splitter islands.
- The requirement for providing a distance of 300 feet from the ramp intersections to the first intersection for limited access right-of-way cannot be achieved; however the limited access right-of-way could be extended 300 feet along each leg of the connector roads.

Roundabouts at Ramp Terminals:

Both roundabouts and stop-control were considered for the ramp terminal intersections for the Build Alternative 3 – Option 1. As noted above, roundabouts at the ramp terminals were found to be problematic from a design standpoint due to the profile grade along Odd Fellows Road, as well as the desire to shift the ramp intersections as close as possible to the bridge structure to increase the spacing to the adjacent intersections north and south of the interchange. Nonetheless, a capacity analysis was conducted in SIDRA to evaluate the potential operations of roundabouts at the ramp terminals. Those results are compared to the operations of the stop-controlled intersections assumed initially in Table 4-4.

Table 4-4. Ramp Terminal Intersection Operations Comparison – Roundabouts vs. Stop Control

Intersection	Alternative 3 – Option 1 Roundabout – Single Lane						Alternative 3 – Option 1 Stop Control					
	LOS		Delay (sec/veh)		Max Queue		LOS		Delay (sec/veh)		Max Queue	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Eastbound Route 460 Ramps at Odd Fellows Road												
EB Route 460 Off-Ramp Left	B	B	13	12	100	90	B	B	17	15	195	145
EB Route 460 Off-Ramp Right							A	A	5	6	75	130
SB Odd Fellows Left	A	A	8	9	-	-	A	A	3	4	55	75
SB Odd Fellows Thru							Free flow					
NB Odd Fellows Thru/Right	B	B	11	10	85	100	Free flow					
Overall	B	B	11	10	-	-	n/a					
Westbound Route 460 Ramps at Odd Fellows Road												
WB Route 460 Off-Ramp Left	C	B	18	14	150	60	B	B	16	14	180	160
WB Route 460 Off-Ramp Right							A	A	6	4	115	75
NB Odd Fellows Left	A	A	8	9	-	-	A	A	3	3	55	65
NB Odd Fellows Thru							Free flow					
SB Odd Fellows Thru/Right	B	B	11	15	110	210	Free flow					
Overall	B	B	12	13	-	-	n/a					

The results in Table 4-4 indicate that both the stop control and roundabout options would provide acceptable operations at the ramp terminal intersections. In terms of safety, roundabouts would be expected to reduce potential vehicular conflicts and collisions compared to the stop-control alternative. However, with the relatively low delays and short queues anticipated with the stop control option, drivers would not be expected to become more aggressive at this site and accept smaller gaps in the cross-street traffic; therefore, there is no reason to think that the proposed stop-control intersections would operate unsafely. This means that final decision on whether to implement roundabouts as part of the Preferred Build Alternative could reasonably be determined by the design issues. Due to the specific design requirements for Option 1, which included shifting the eastbound Route 460 ramps closer to the bridge over Route 460 to maximize the potential spacing between the ramp terminal intersection and the future Top Ridge Road connector roundabout, roundabouts at the ramp terminal intersections were not included in the design for the Preferred Build Alternative evaluated in this IJR.

5. ROADWAY GEOMETRY

5.1. Design / Geometric Criteria

This chapter summarizes the geometric criteria used in the development of the conceptual design for the proposed Route 460 / Odd Fellows Road interchange and associated roadway improvements. The terrain is defined as rolling for all the roadways located within the project limits. Table 5-1 provides details on the Design Criteria for this project.

The FHWA functional classification for this segment of Route 460 is Urban Freeway and Expressway; Route 460 is a four-lane divided roadway (two lanes in each direction) with a variable-width grass median separating the opposing travel lanes. The appropriate VDOT Geometric Design Standard for this segment of Route 460 is GS-5 (Urban Principal Arterial – Other Principal Arterial with Shoulder Design) as defined in Appendix A of the VDOT RDM. The FHWA functional classification for Odd Fellows Road is GS-6 (Urban Minor Arterial) as defined in the VDOT RDM. The design of the new interchange ramps at Odd Fellows Road follows the VDOT Geometric Design Standard GS-R in Appendix A of the VDOT RDM.

5.2. Waivers / Exceptions

All roadways and ramps are being designed in accordance with applicable guidelines published by the American Association of State Highway and Transportation Officials (AASHTO), 2011 edition. One potential Design Exception has been identified for the Route 460 mainline, but none for the interchange ramps, or the local street network. Additionally, due to existing topographical and right-of-way constraints, two potential Design Waivers have been identified along Route 460. Access Management Waivers will likely be required for proposed access points along Odd Fellows Road north and south of the interchange with Route 460. Additional detail regarding the potential Design Exceptions and Design Waivers is summarized below:

Potential Design Exceptions:

Route 460 Mainline

1. Superelevation – Two existing curves along Route 460 are superelevated at 2.0% which satisfied the original design speed of 60 mph. Based on the new posted speed (65 mph) and design speed for this project (70 mph), the minimum required superelevation would be 3.6%. It is not anticipated that this Design Exception would impact safety along Route 460. The two curves in question are an existing condition and the crash data does not indicate an issue with the superelevation in this area.

Potential Design Waivers:

Route 460 Mainline

1. Inside Paved Shoulder Width – The existing inside paved shoulder width along Route 460 is 3 feet. The minimum required paved shoulder width for a 70 mph design speed is 4 feet.

2. Clear Zone within Median – The existing available clear zone width within the median of Route 460 ranges from 10 to 15 feet within the project area. The required clear zone width for a 70 mph design speed is 30 feet.

Access Management Waivers (AM-3) will likely be required for access points along Odd Fellows Road both and north and south of the interchange with Route 460. The proposed spacing (approximately 360 feet) between the intersection of Odd Fellows Road and Top Ridge Road / Future Liberty University Connector and Odd Fellows Road and the eastbound Route 460 ramp terminal intersection does not satisfy the minimum spacing requirement of 1,320 feet for intersections adjacent to interchange ramps as defined in Appendix F of the VDOT Road Design Manual; this will require an access management waiver as part of this project. Additionally, the proposed spacing (approximately 370 feet) between the intersection of Odd Fellows Road and John Capron Road (future roadway connection) and the Route 460 westbound ramp terminal intersection would not satisfy the 1,320 feet minimum spacing requirement. At this time, whether access from John Capron Road (currently a dirt road) will be included in this project has not been decided. If a connection is designed and constructed as part of this project, then an Access Management Waiver would be required for that connection. Even if a connection to John Capron Road is not provided, there are a number of existing commercial driveways which would be located less than 750 feet (minimum distance to right-in / right-out access) or 1,320 feet (minimum distance to full intersection) from the Route 460 westbound ramp terminal intersection. These commercial entrances would also require Access Management Waivers.

5.3. Conceptual Design Plans and Typical Sections

A plan view of the conceptual design for the proposed improvements and proposed typical sections for the Route 460 / Odd Fellows Road interchange are provided in Appendix G.

Table 5-1 presents the lengths of the proposed acceleration and deceleration lanes along Route 460. Table 5-2 presents the VDOT Geometric Design Criteria for this project for all necessary roadways.

Table 5-1. Preferred Alternative – Available Acceleration/Deceleration Lengths

Ramp	Available Acceleration/Deceleration Lengths (ft)*	AASHTO Recommended Length (ft)
Eastbound Off-Ramp	600	340
Eastbound On-Ramp	600	580
Westbound Off-Ramp	600	340
Westbound On-Ramp	672	580

*Measured between start of full-width lane to PT or PC of limiting ramp curve (50 mph). The AASHTO Recommended Lengths are supplied in the AASHTO Green Book Exhibits 10-70 and 10-73. The values presented in Table 5-1 reflect a design speed of 50 mph for the entrance and exit curves along each ramp. As noted in Table 5-2, the minimum ramp design speed was established as 35 mph, but the entrance and exit curves are being designed to higher speeds; those higher speeds are reflected in this table to determine the adequacy of the available acceleration and deceleration lengths.

Table 5-2. VDOT Geometric Design Criteria

ROADWAY INVENTORY AND DESIGN GUIDE																																	
ROADWAY NAME	STATE ROUTE NO.	CLASSIFICATION (URBAN)	GEOMETRIC DESIGN STANDARD	TERRAIN	EXIST. POSTED SPEED (MPH)	DESIGN SPEED (MPH)	VDOT RDM Jul. 2012 MINIMUM CURVE RADIUS (FT.)	MAX. RATE OF SUPER.	MAX. % GRADE	SIGHT DISTANCES		VERTICAL ALIGNMENT		CLEAR ZONE (FEET)	NUMBER OF LANES (TYP)	LANE WIDTH (1) (FEET)	MEDIAN		CURB OR C & G	BERM WIDTH FROM FACE OF CURB (FEET)	MINIMUM WIDTH OF SHOULDER (PAVED + GRADED)						SHOULDER WIDTH		FRONT DITCH WIDTH (FEET)	FRONT DITCH SLOPE	SIDE SLOPE	MINIMUM BRIDGE WIDTHS (FEET)	MINIMUM VERTICAL CLEARANCE (FEET)
										STOPPING	DECISION	"K" CREST	"K" SAG				W/ GR	W/OUT			FILL	CUT	W/ GR	W/OUT	FILL	CUT	LEFT OR INSIDE (FEET)	RIGHT OR OUTSIDE (FEET)					
										MINIMUM	MINIMUM	MINIMUM	MINIMUM																				
										(FEET)	(FEET)	(FEET)	(FEET)																				
ROUTE 29/460 (LYNCHBURG BYPASS)	29 460	URBAN PRINCIPAL ARTERIAL (FREEWAY)	GS-5	ROLLING	65	70	1815	8%	4%	730	NA	247	181	30' MIN.	4	12	varies 30 156	DEPRESS INDEPEN	NA	NA	11	8	6	17	14	14	EXIST. 3 Need 4'	12	12	6:1	2:1		
ODD FELLOWS ROAD and ODD FELLOWS EXTENSION	NA	URBAN MINOR ARTERIAL	GS-6	ROLLING	35	40	536	4%	8%	305	NA	44	64	14 MIN.	TBD	12	16	RAISED	CG-2 MEDIAN CURB	NA	NA	NA	13	10	10	NA	8	6	4:1	2:1	FULL APPROACH WIDTH	16.5 ROADWAY	
TOP RIDGE ROAD	NA	URBAN LOCAL	GS-8	ROLLING	NA	30	251	4%	15%	200	NA	19	37	14 MIN.	2	10' MIN	NA	NA	NA	NA	NA	11	8	8	0	0	4	3:1	2:1				
RAMP A (EB OFF)	NA	INTERCHANGE RAMP	GS-R	ROLLING	NA	35 MIN.*	314	8%	4-6%	250	NA	29	49	14	1	16 MIN.	NA	NA	NA	NA	9	6	6	13	10	10	4	8	10	6:1	2:1		
RAMP B (EB ON)	N/A	INTERCHANGE RAMP	GS-R	ROLLING	NA	35 MIN.*	314	8%	4-6%	250	NA	29	49	14	1	16 MIN.	NA	NA	NA	NA	9	6	6	13	10	10	4	8	10	6:1	2:1		
RAMP C (WB OFF)	NA	INTERCHANGE RAMP	GS-R	ROLLING	NA	35 MIN.*	314	8%	4-6%	250	NA	29	49	14	1	16 MIN.	NA	NA	NA	NA	9	6	6	13	10	10	4	8	10	6:1	2:1		
RAMP D (WB ON)	NA	INTERCHANGE RAMP	GS-R	ROLLING	NA	35 MIN.*	314	8%	4-6%	250	NA	29	49	14	1	16 MIN.	NA	NA	NA	NA	9	6	6	13	10	10	4	8	10	6:1	2:1		

*Minimum Ramp Design Speed is 35 mph. Entrance and exit curves will be designed to higher speeds in accordance with the applicable AASHTO and VDOT criteria.

6. TRAFFIC DATA

6.1. Traffic Data Collection

This IJR utilizes traffic data collected in November 2011. The data collection dates were coordinated to occur when local schools and Liberty University were in session. Along roadway links, machine counts were conducted to collect data by vehicle type, corresponding with FHWA's 13 vehicle classifications. Manual turning movement counts were also acquired at four (4) intersections within the Study Area.

6.1.1. Daily Volume Counts

In November 2011, classified daily volume data was collected at the following sixteen (16) locations. Counts were obtained for three (3) consecutive days at these locations.

1. Route 460 (Between Candler's Mountain Road and Campbell Avenue)
2. Candler's Mountain Road
3. Odd Fellows Road
4. Route 460 at Candler's Mountain Road – Eastbound Off-Ramp
5. Route 460 at Candler's Mountain Road – Eastbound On-Ramp
6. Route 460 at Candler's Mountain Road – Westbound Off-Ramp
7. Route 460 at Candler's Mountain Road – Westbound On-Ramp
8. Route 460 at Campbell Avenue – Eastbound Off-Ramp
9. Route 460 at Campbell Avenue – Eastbound On-Ramp
10. Route 460 at Campbell Avenue – Eastbound On-Loop
11. Route 460 at Campbell Avenue – Westbound Off-Ramp
12. Route 460 at Campbell Avenue – Westbound On-Ramp
13. Business Route 29 at Odd Fellows Road – Eastbound Off-Ramp
14. Business Route 29 at Odd Fellows Road – Eastbound On-Ramp
15. Business Route 29 at Odd Fellows Road – Westbound Off-Ramp
16. Business Route 29 at Odd Fellows Road – Westbound On-Ramp

6.1.2. Intersection Turning Movement Counts

In November 2011, AM and PM peak period intersection turning movement counts were obtained at the following four (4) locations:

1. Odd Fellows Road at Mayflower Drive
2. Candler's Mountain Road at Mayflower Drive
3. Campbell Avenue at Eastbound Route 460 ramp terminals
4. Campbell Avenue at Westbound Route 460 ramp terminals

Figure 6-1 depicts the locations and types of traffic data collected for this study.

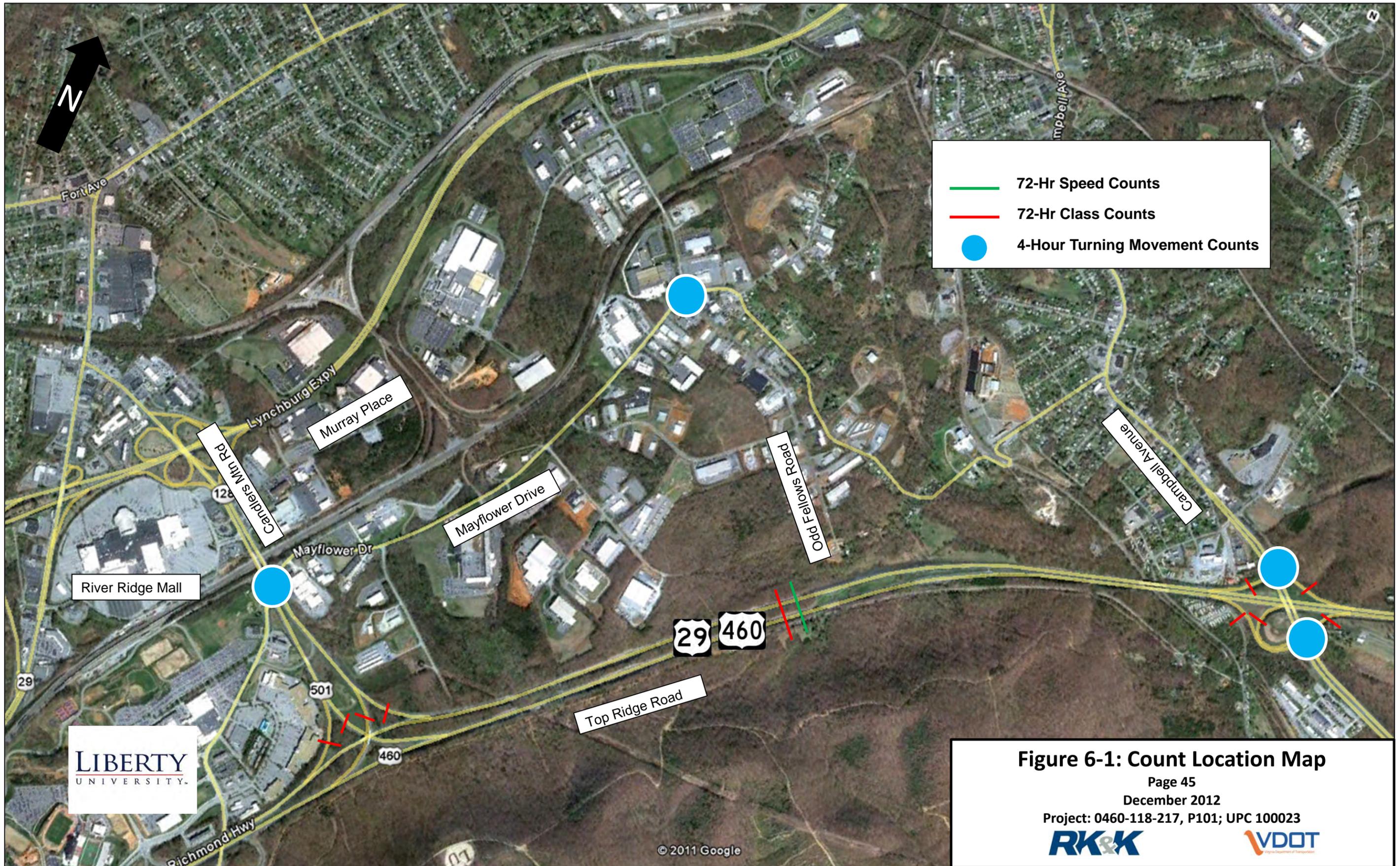


Figure 6-1: Count Location Map
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 Project: 0460-118-217, P101; UPC 100023
 RK&K VDOT

6.2. 2011 Existing Volume Network

The existing (2011) traffic volume data was reviewed and a network of existing AADTs and AM and PM peak hour volumes was developed for the Study Area along the Route 460 and Odd Fellows Road corridors.

Daily Traffic Volumes

Using the aforementioned counts and existing traffic data available from VDOT, the average daily traffic (ADT) volumes were determined for Odd Fellows Road, Business Route 29, Candler's Mountain Road, and Route 460. These values are presented in Table 6-1. The existing 2011 daily traffic volumes are summarized in Figure 6-2.

Table 6-1. Route 460 / Odd Fellows Road IJR Study Area AADT Summary

Ramp or Cross Street	AADT	Truck %
Odd Fellows Road (South of Mayflower Drive)	1,550	26%
Odd Fellows Road (North of Mayflower Drive)	8,700	14%
Business Route 29	39,000	2%
Candler's Mountain Road, North of Mayflower Drive	36,000	4%
Route 460 (Between Candler's Mountain Road and Campbell Avenue)	36,300	8%

Existing Peak Hour Traffic Volumes

An existing network of AM and PM peak hour volumes were developed using the count data (link and intersection counts). Volumes along Route 460 were balanced between adjacent interchanges, reflecting the lack of access points along this limited access facility. Volumes along the local street network, including Candler's Mountain Road, Odd Fellows Road, Campbell Avenue, and Mayflower Drive were balanced where appropriate. Along links with multiple access points between study intersections, volumes were left unbalanced. The existing 2011 balanced AM and PM peak hour volumes are summarized in Figures 6-3.

6.3. Development of Future Traffic Forecasts

Future traffic volume forecasts were generated for Opening Year (2016) and Design Year (2035) conditions. Forecasts were developed for the No Build (no new interchange at Route 460 / Odd Fellows Road) and Build Alternatives. The improvements assumed for the Build Alternative include the extension of Odd Fellows Road from its current terminus and construction of a new grade-separated interchange between Odd Fellows Road and Route 460. VDOT currently plans to provide a short "stub-out" terminating at a roundabout which would enable future access (via a new local roadway system) to the area south of the interchange.

Concepts for any future development and new local roadway connections south of the interchange are still in the preliminary phases and have not been formally adopted. However, to properly account for the impacts of this potential future development, the traffic forecasts for the Build Alternative include trips anticipated to be generated by the land uses depicted in a preliminary concept plan from Liberty University for the area south of the interchange.

This section describes the methodology that was used to develop the daily and peak hour forecasts and presents the resulting volumes for each of the analysis years for the No Build and Build Alternatives.

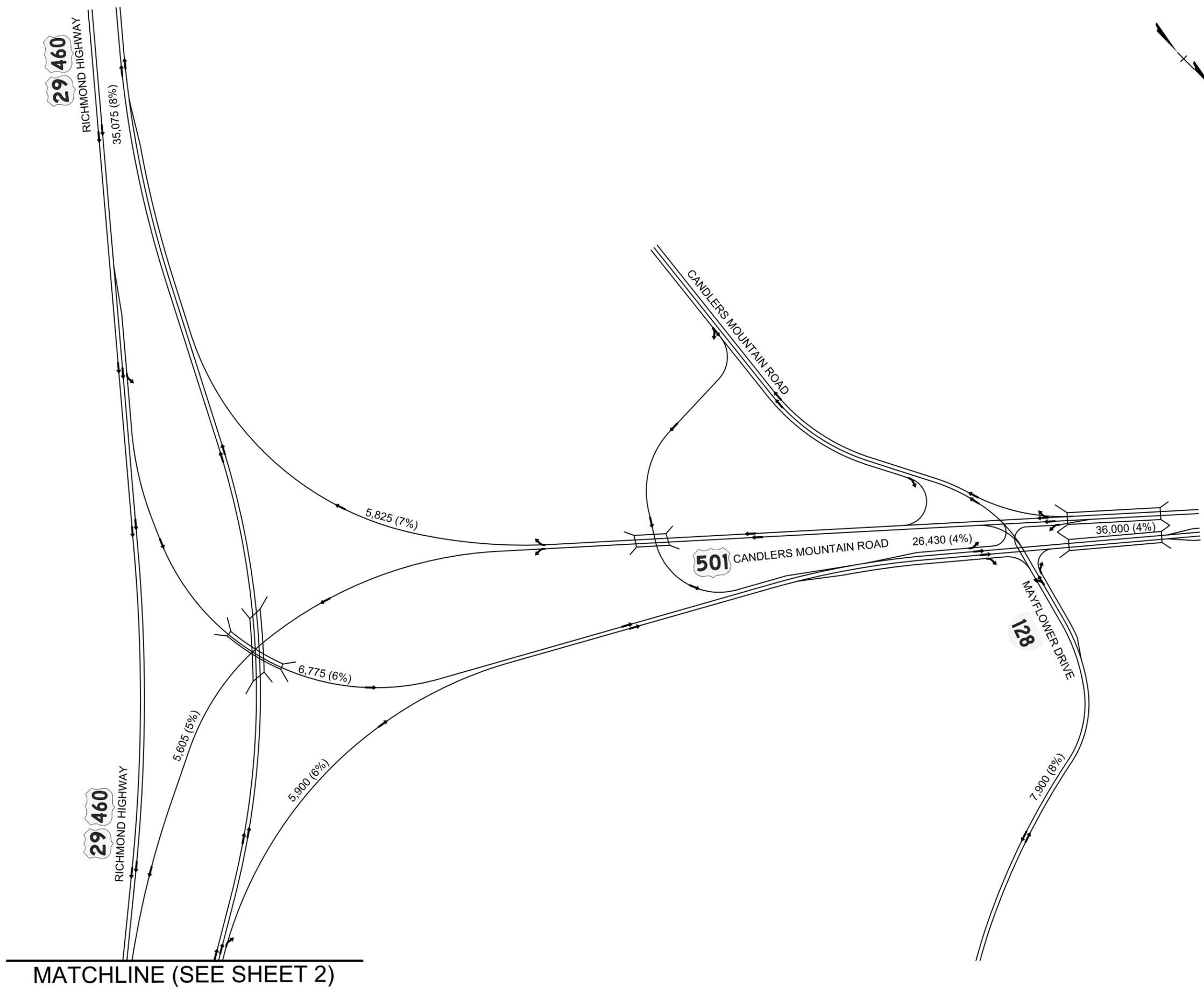
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2011 AVERAGE DAILY
TRAFFIC VOLUMES
SHEET 1 OF 6

LEGEND	FIGURE
← Existing Number of Lanes ← on Roadway Segments	6-2
AADT VOLUME (TRUCK %)	



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

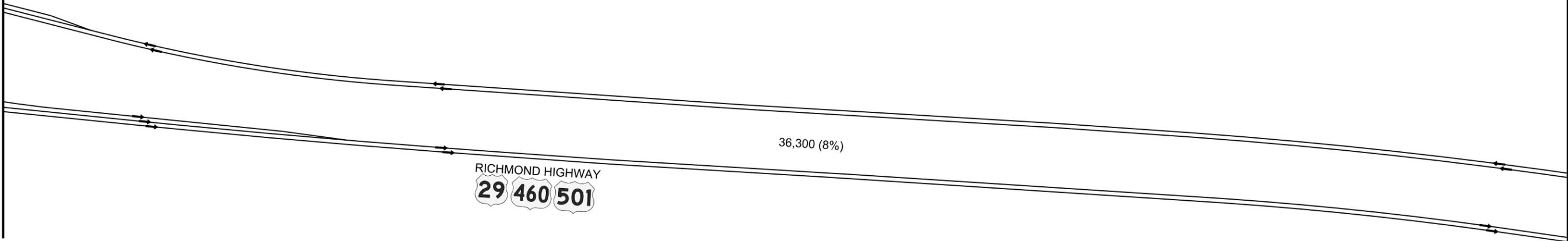
2011 AVERAGE DAILY
TRAFFIC VOLUMES
SHEET 2 OF 6

LEGEND
 ← Existing Number of Lanes
 ← on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-2



MATCHLINE (SEE SHEET 1)



MATCHLINE (SEE SHEET 3)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2011 AVERAGE DAILY
TRAFFIC VOLUMES
SHEET 3 OF 6

LEGEND	FIGURE
Existing Number of Lanes on Roadway Segments AADT VOLUME (TRUCK %)	6-2

MATCHLINE (SEE SHEET 6)



MATCHLINE (SEE SHEET 2)



MATCHLINE (SEE SHEET 4)

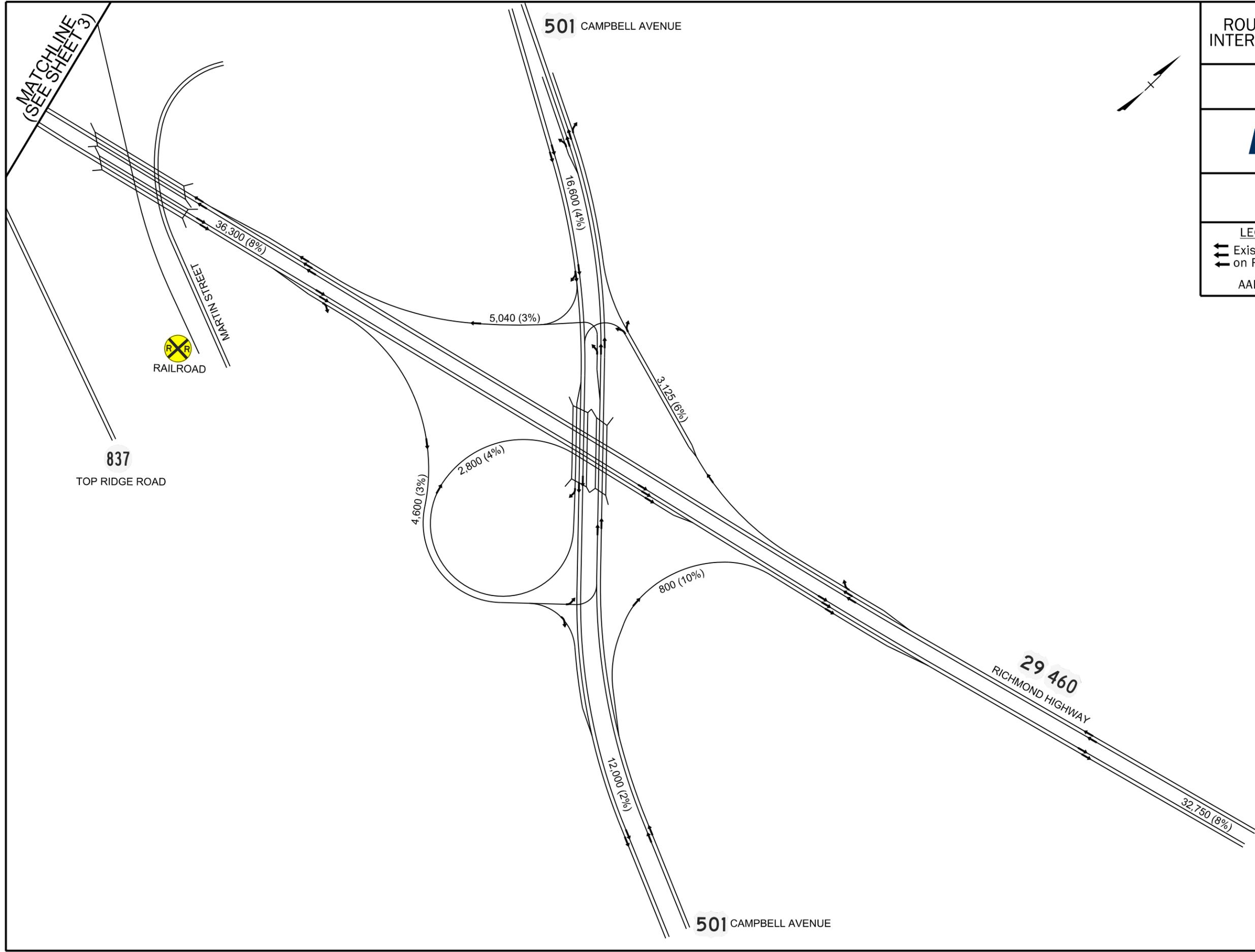
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2011 AVERAGE DAILY
TRAFFIC VOLUMES
SHEET 4 OF 6

LEGEND	FIGURE
<ul style="list-style-type: none"> ← Existing Number of Lanes ← on Roadway Segments 	6-2
AADT VOLUME (TRUCK %)	



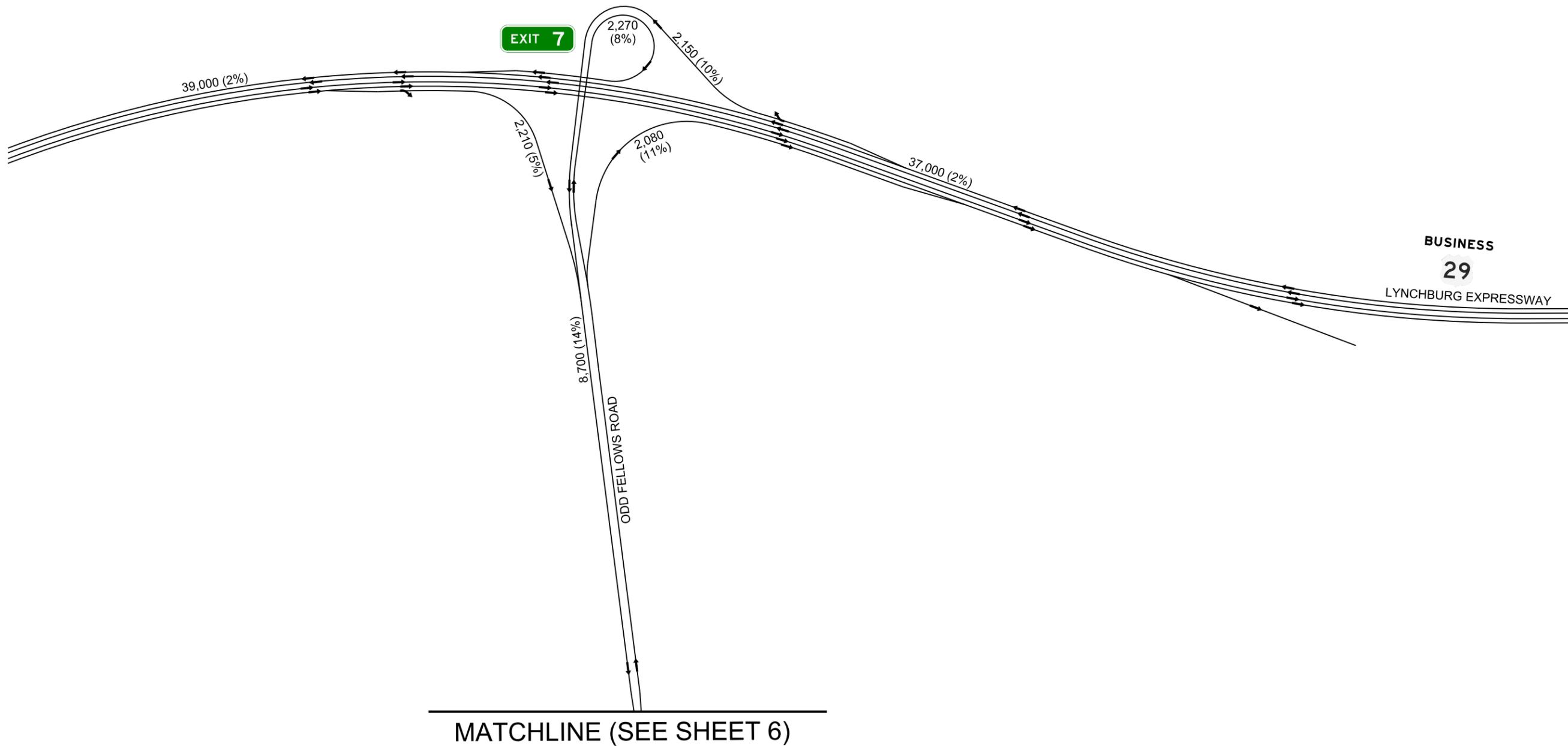
ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2011 AVERAGE DAILY TRAFFIC VOLUMES
SHEET 5 OF 6

LEGEND	FIGURE
<ul style="list-style-type: none"> ← Existing Number of Lanes ← on Roadway Segments 	6-2
AADT VOLUME (TRUCK %)	



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



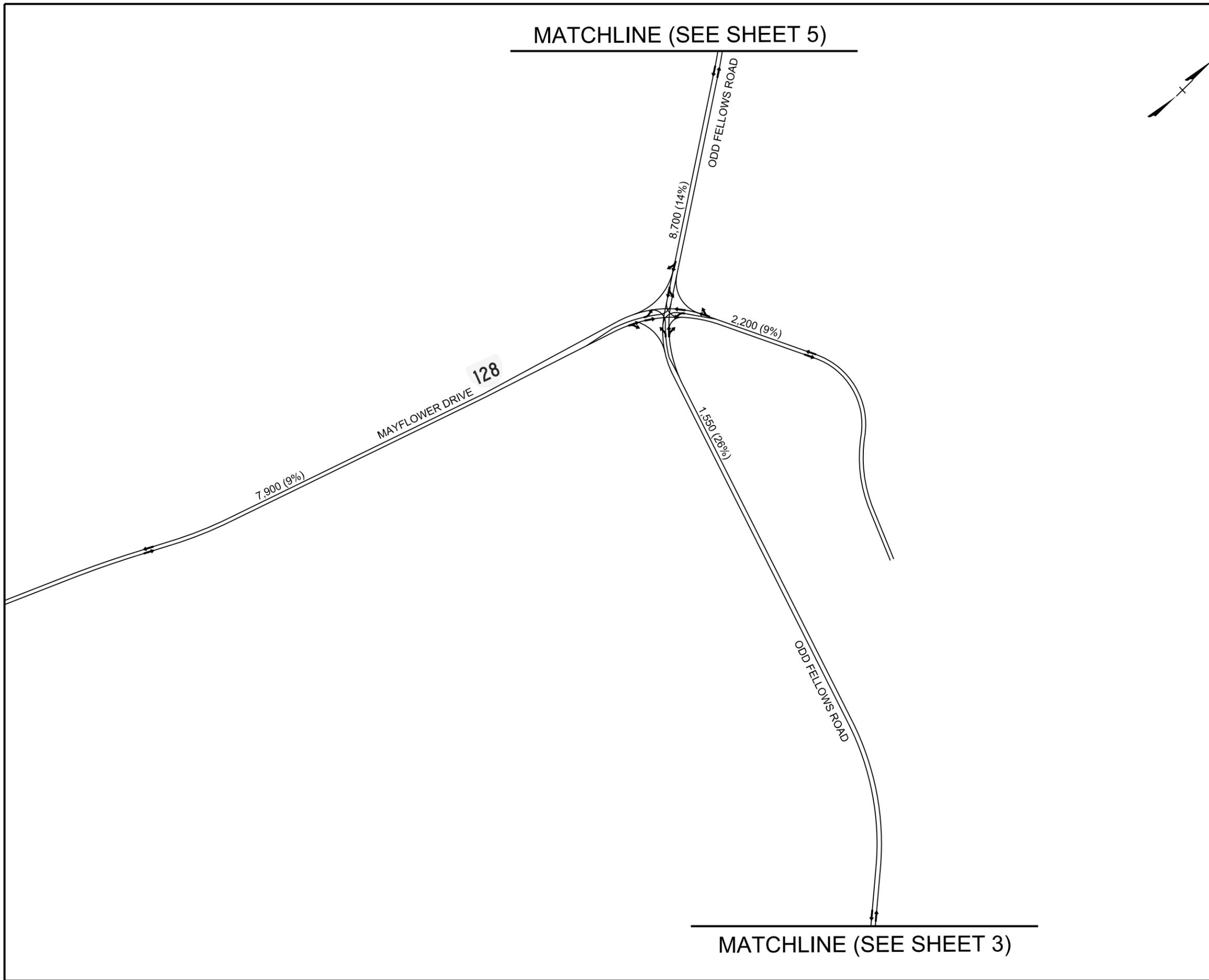
DATE:
DECEMBER 2012

2011 AVERAGE DAILY
TRAFFIC VOLUMES
SHEET 6 OF 6

LEGEND
 ← Existing Number of Lanes
 ← on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE

6-2



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

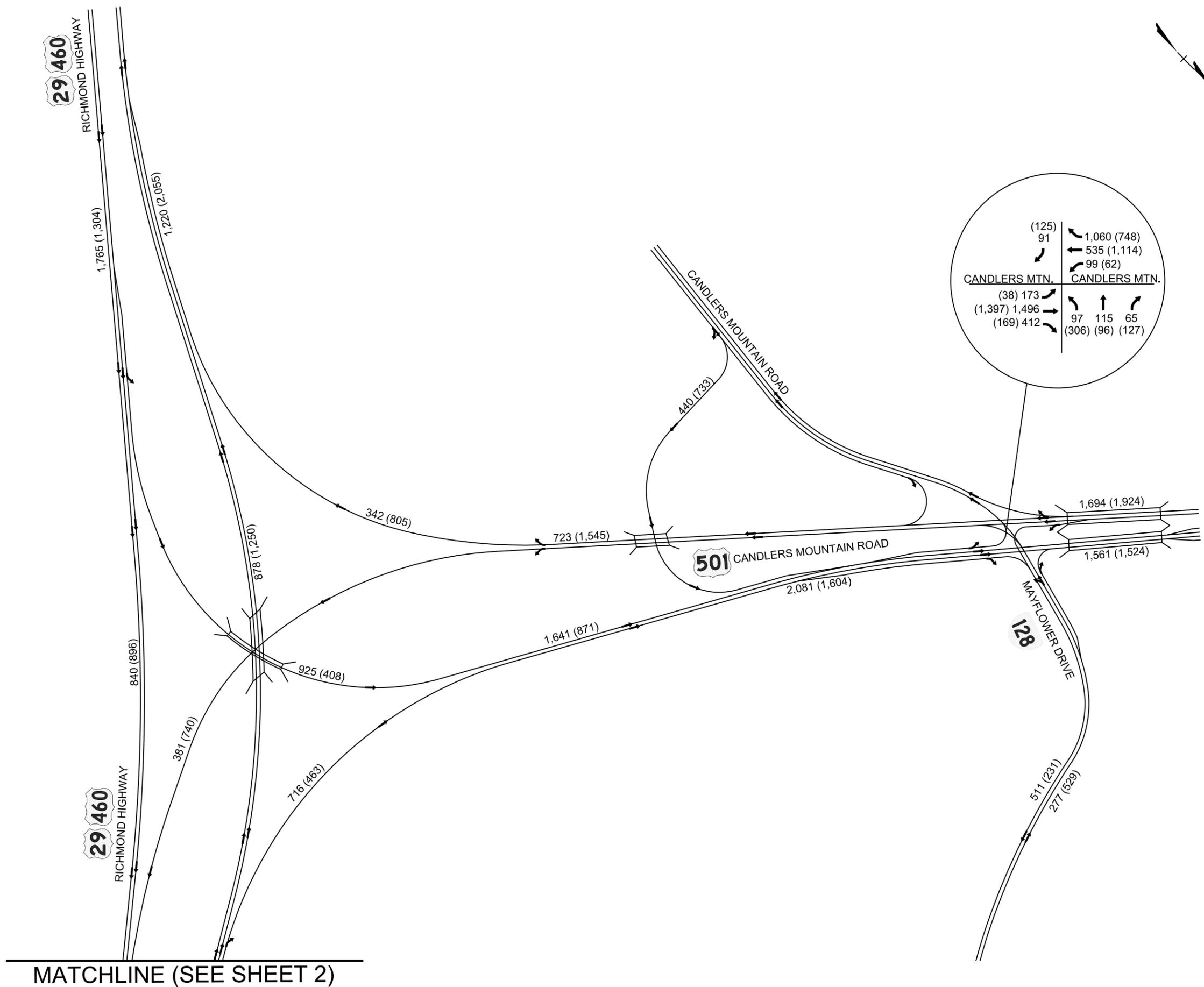


DATE:
DECEMBER 2012

2011 AM(PM)
EXISTING PEAK HOUR VOLUMES
SHEET 1 OF 6

LEGEND
 Existing Number of Lanes
 on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-3



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

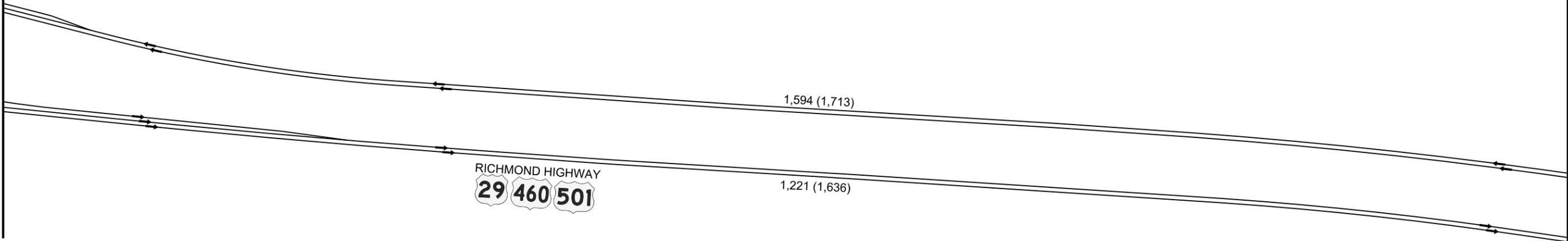
2011 AM(PM)
EXISTING PEAK HOUR VOLUMES
SHEET 2 OF 6

LEGEND
← Existing Number of Lanes
← on Roadway Segments
ADT VOLUME (TRUCK %)

FIGURE
6-3



MATCHLINE (SEE SHEET 1)



MATCHLINE (SEE SHEET 3)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

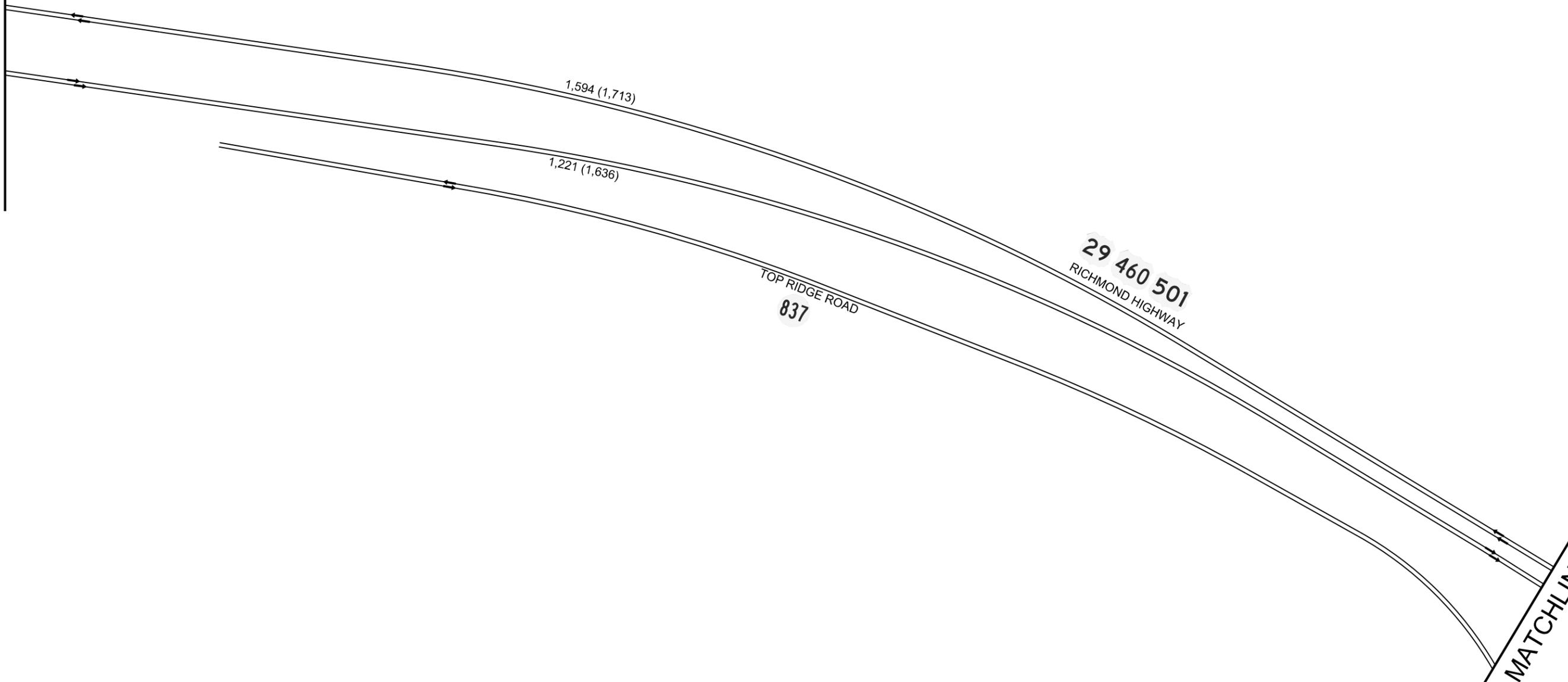
2011 AM(PM)
EXISTING PEAK HOUR VOLUMES
SHEET 3 OF 6

LEGEND	FIGURE
← Existing Number of Lanes on Roadway Segments	6-3
AADT VOLUME (TRUCK %)	

MATCHLINE (SEE SHEET 6)



MATCHLINE (SEE SHEET 2)



MATCHLINE (SEE SHEET 4)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

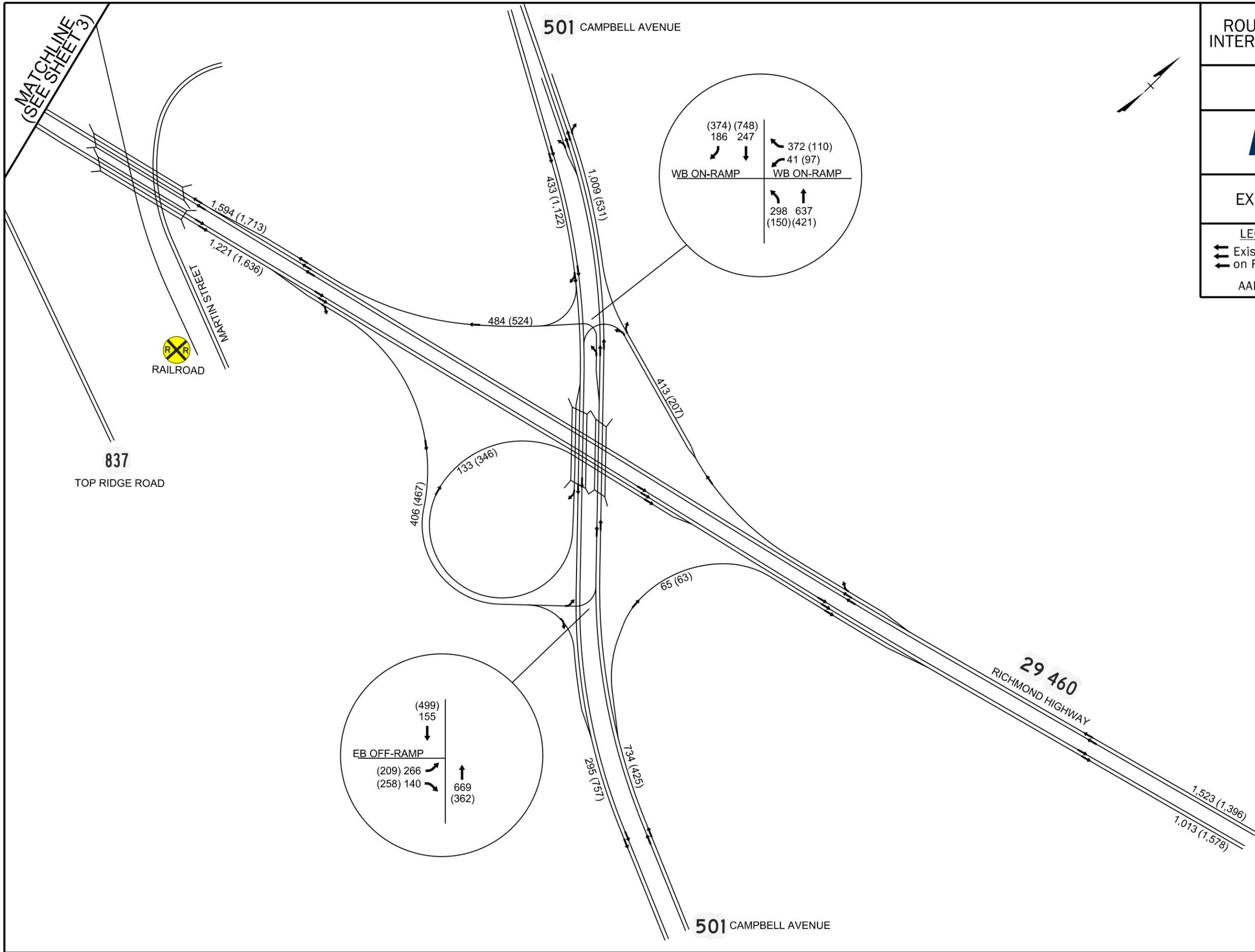


DATE:
DECEMBER 2012

2011 AM(PM)
EXISTING PEAK HOUR VOLUMES
SHEET 4 OF 6

LEGEND
 Existing Number of Lanes
 on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-3



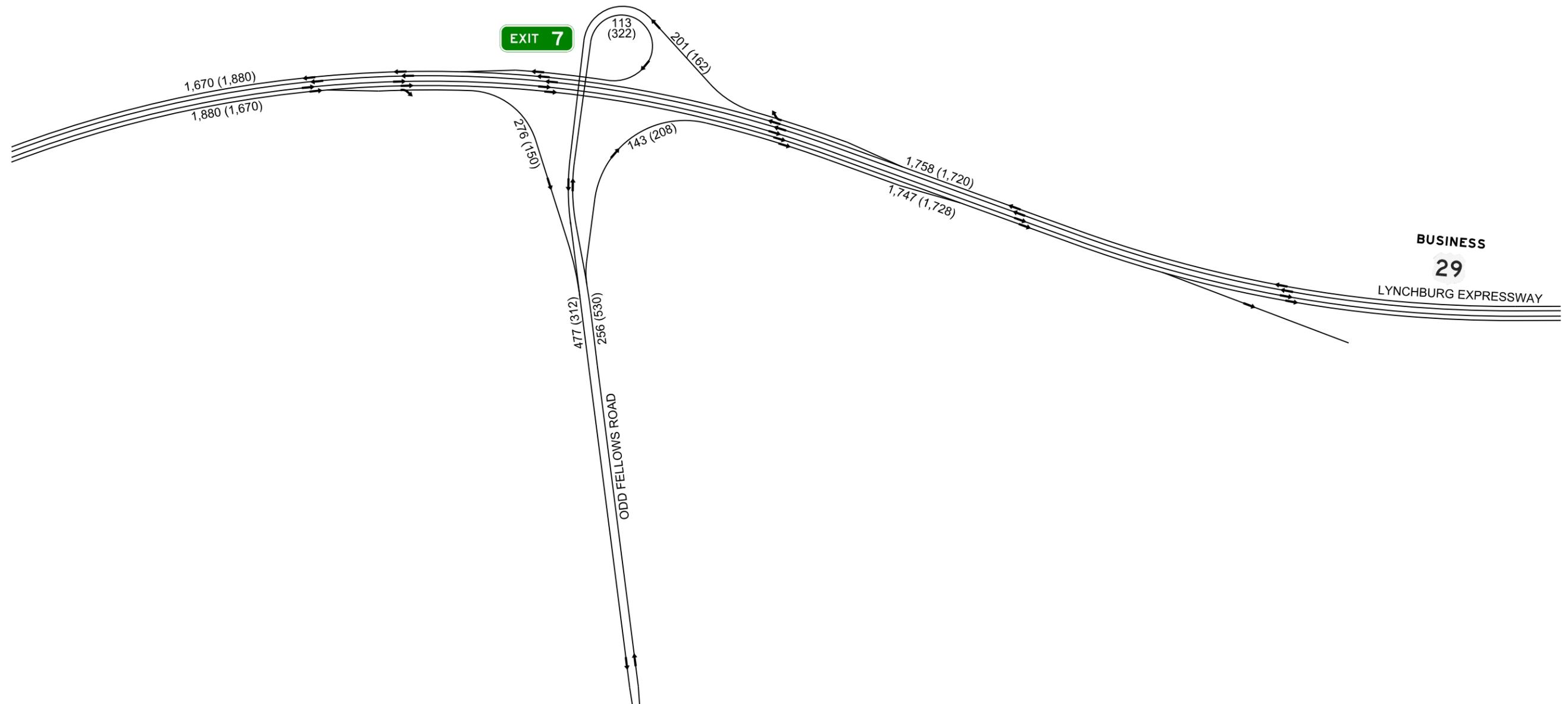
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2011 AM(PM)
EXISTING PEAK HOUR VOLUMES
SHEET 5 OF 6

LEGEND		FIGURE
←	Existing Number of Lanes on Roadway Segments	6-3
	AADT VOLUME (TRUCK %)	



BUSINESS
29
LYNCHBURG EXPRESSWAY

MATCHLINE (SEE SHEET 6)

ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT

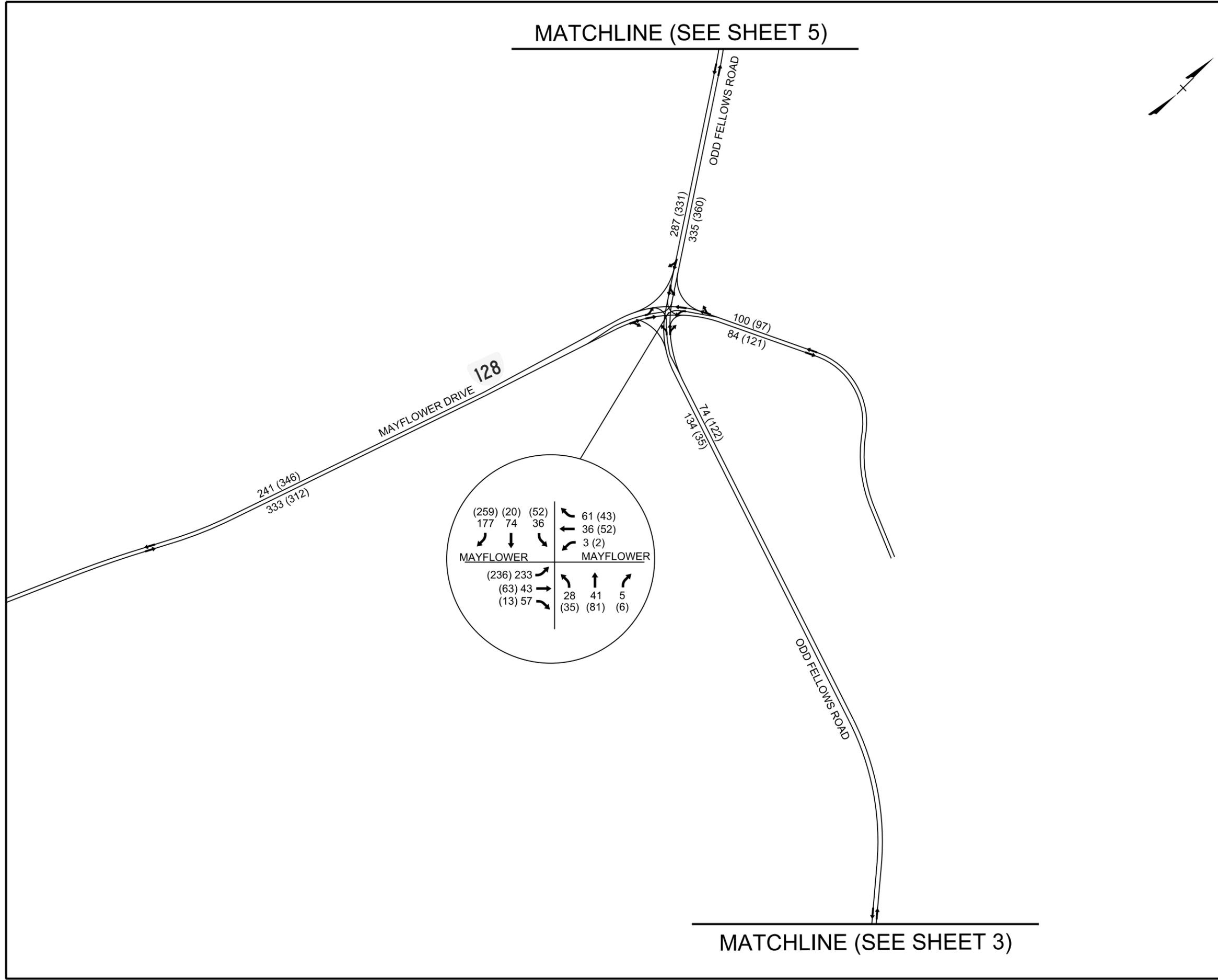


DATE:
DECEMBER 2012

2011 AM(PM)
EXISTING PEAK HOUR VOLUMES
SHEET 6 OF 6

LEGEND
 Existing Number of Lanes
 on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-3



6.3.1. Future No Build Forecasts

Opening Year (2016) and Design Year (2035) No Build forecasts for the Study Area were developed by applying growth rates to the existing observed daily traffic volumes. Then appropriate K-factors and turning movement percentages were applied to the projected daily traffic volumes to estimate the future weekday AM and PM peak hour turning movement volumes.

Growth Rates

The latest version of the Lynchburg Area Travel Demand Model (LATDM) was obtained from VDOT. A thorough review of the Region 2000 / Central Virginia Metropolitan Planning Organization (CVMPO) Central Virginia Long Range Transportation Plan was performed to verify that all the projects (aside from the study project) included in the Fiscally Constrained Long-Range Plan were accounted for in the future 2035 roadway network in the LATDM. Aside from the proposed Route 460 / Odd Fellows Road interchange, the model accounted for all 2035 CLRP projects with the exception of widening Greenview Drive from Hermitage Road to Leesville Road from 2-lanes to 4-lanes. This project was added to the model for the No-Build future year analysis.

The LATDM was also reviewed to confirm that the model reflects the latest approved land use projections for the Study Area. Coordination occurred with Region 2000 / CVMPO staff to obtain the latest approved population, household, and employment projections summarized by Traffic Analysis Zone (TAZ). These projections were then compared to the land use information contained in the model and it was determined that no modifications to the land use data were required.

Projected Regional Traffic Growth from LATDM

After the future No Build transportation network and future land use forecasts were reviewed, the model was run for both the 2008 (Base Year) and 2035 (Horizon Year) scenarios. Daily link assignments were summarized for both the 2008 and 2035 model runs and total growth over the 28-year period, as well as composite annual growth rates, were computed. Table 6-2 summarizes the average annual growth rates for all roadways in the study area and separately reports the average growth rates for north-south and east-west routes. The reason for determining the separate growth rates by direction is to conform to the orientation of the major facilities within the City, which are predominately oriented east-west and are anticipated to grow at a faster rate than the more service oriented north-south facilities.

Table 6-2. Overall Annual Growth Rates within the Study Area

Facility Direction	Annual Growth Rate 2008 to 2035 (Percent)
Overall	0.70%
North-South	0.57%
East-West	1.01%

Table 6-3 summarizes the growth rates observed on individual facilities within the study area.

Table 6-3. LATDM Annual Growth Rates within the Study Area, by Facility

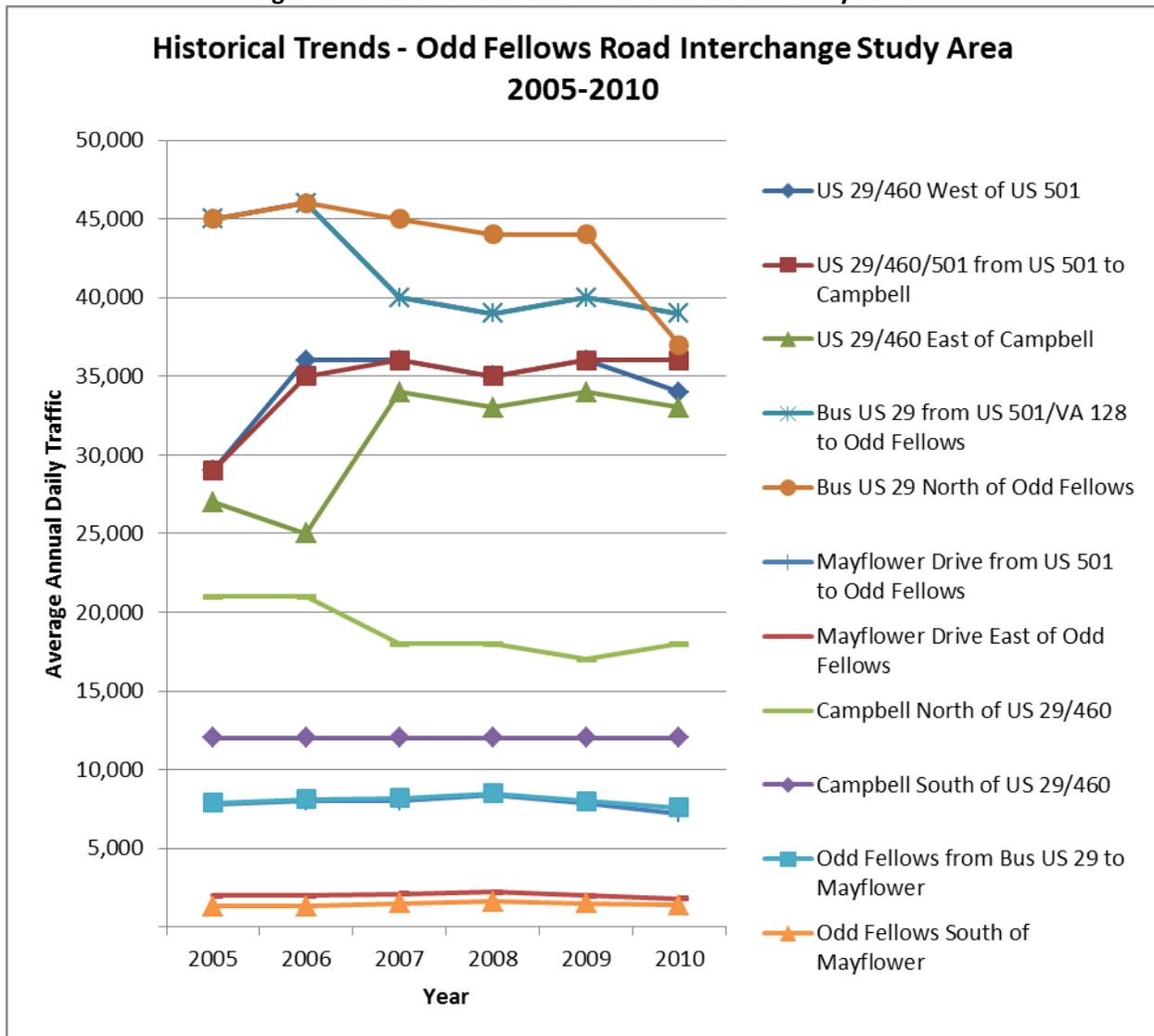
Facility Direction	Annual Growth Rate 2008 to 2035 (Percent)
Route 460	Varies – 1.2 to 1.3%
Candlers Mountain Road	Varies – 0.4 to 0.9%
Campbell Avenue, North of Route 460	0.7%
Mayflower Drive, West of Odd Fellows	0.6%
Odd Fellows Road, North of Mayflower	0.3%
Business Route 29	Varies - 0.4 to 0.5%

The projected growth trends on two corridors, Route 460 and Candlers Mountain Road, exceed the overall growth rates observed within the Study Area. Based on these results, the decision was made to assign a conservatively high annual growth rate of 1.5% for the Route 460 corridor. For Candlers Mountain Road, a wide range of growth rates were observed along the corridor using the LATDM data and the higher-end of that range was used to identify an annual growth rate of 1.0%. For each of the remaining facilities in the study area, the growth rates observed in the LATDM were less than 0.75% per year; therefore, a 0.75% annual growth rate was identified for each of those facilities. This rate matches the overall average growth rate projected by the LATDM for the Study Area and was determined to be appropriately conservative for this analysis.

Recent Historical Traffic Trends within the Study Area

Before using the annual growth rates identified from the LATDM analysis, a review of historical daily traffic volumes for the roadways within the Study Area was also conducted. Data was obtained from VDOT’s publicly-available traffic count summary reports. Figure 6-4 summarizes the historical traffic volumes from 2005 through 2010 for the key facilities within the study area. For most of the roadways within the study area, traffic volumes have been flat since 2005. There are two notable exceptions: the Lynchburg Expressway (Business Route 29) and Route 460. Volumes on the Lynchburg Expressway experienced a sharp decrease between 2006 and 2007, while volumes on Route 460 experienced a substantial increase. This shift in traffic volumes appears to coincide with the opening of the Route 29 Madison Heights Bypass. Since 2007, volumes on both facilities have been essentially flat.

Figure 6-4. Historical Traffic Growth within the Study Area



No Build Daily Traffic Volumes

The review of recent historical trends within the study area indicated minimal growth in traffic volumes within the Study Area. However, caution should be applied when reviewing recent historical traffic data, as these volumes have likely been influenced by several significant factors, including historically high gas prices and a severe economic recession, which may have impacted the short-term trends. Because the LATDM considers longer-term historical trends and long-range future land use assumptions, it was concluded that the growth rates obtained from the LATDM would be most appropriate for developing the forecasts for this analysis. These growth rates are summarized in Table 6-4. These rates were applied to the existing 2011 traffic volumes to generate No Build 2016 Opening Year and 2035 Design Year average daily traffic forecasts within the study area. It should be noted that for interchanges and intersections between two roadways with different growth rates, the growth rate for the upstream facility was applied to the ramp volumes or intersection turning movement volumes. For example, for the southbound Candler Mountain Road ramps to Route 460, the 1% annual growth rate was applied;

for the ramps from Route 460 to northbound Candler's Mountain Road, the 1.5% annual growth rate was applied.

Table 6-4. Assumed Growth Rates for Route 460 / Odd Fellows Interchange Study No Build Forecasts

Traffic Growth Rates Assumed for No Build Forecasts			
Roadway	Annual Growth Rate	Total Growth (2011 to 2016)	Total Growth (2011 to 2035)
Route 460 / Route 29	1.5%	7.8%	43%
Candler's Mountain Road	1.0%	5.1%	27%
All Other Facilities	0.75%	3.8%	20%

The total future Opening Year (2016) and Design Year (2035) No Build AADT forecasts are summarized in Figures 6-5 and 6-6.

No Build Design / Peak Hour Traffic Volumes

The future No Build design hour / peak hour link volumes were developed by applying a K-factor to the future No Build daily traffic volumes. RK&K reviewed available data from VDOT's permanent count stations within the study area. There is an existing permanent count station on Route 460 with a reported K-factor of 10%. This K-factor is intended to represent the 30th-highest hour of traffic during the year. RK&K elected to apply this 10% K-factor to the future No Build daily traffic volumes for Route 460 to determine the design hour link volumes. The K-factors used on the other facilities are shown in Table 6-5. These K-factors were determined using existing count data.

Table 6-5. Assumed K-Factor by Roadway Type

Ramp or Cross Street	K-Factor
Route 460	10%
Campbell Avenue Interchange Eastbound Off-Ramp	9.75%
Southbound Campbell Road Interchange Eastbound On-Ramp	7.50%
Northbound Campbell Road Interchange Eastbound On-Ramp	7.25%
Campbell Road Interchange Westbound Off-Ramp	8.75%
Campbell Road Interchange Westbound On-Ramp	9.50%
All Other Facilities	10%

Once the design hour link volumes were established, RK&K utilized existing AM and PM directional factors and turning proportions to develop design hour turning movement volumes. Typically, design hour volumes are developed by generating one set of turning movement volumes and then simply reversing the direction of those trips to estimate volumes in the other peak period. The original intent was to apply that method for this study. However, the existing traffic counts obtained within the study area do not reflect this type of reverse-directionality for the AM and PM peak periods. For example, Route 460 westbound carries higher traffic volumes than Route 460 eastbound during both the AM and PM peak hours. Similarly, southbound Candler's Mountain Road carries higher traffic volumes than northbound Candler's Mountain Road during both peak hours. The presence of Liberty University and a number of retail land uses may be causing this lack of reverse directionality in the observed volumes.

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

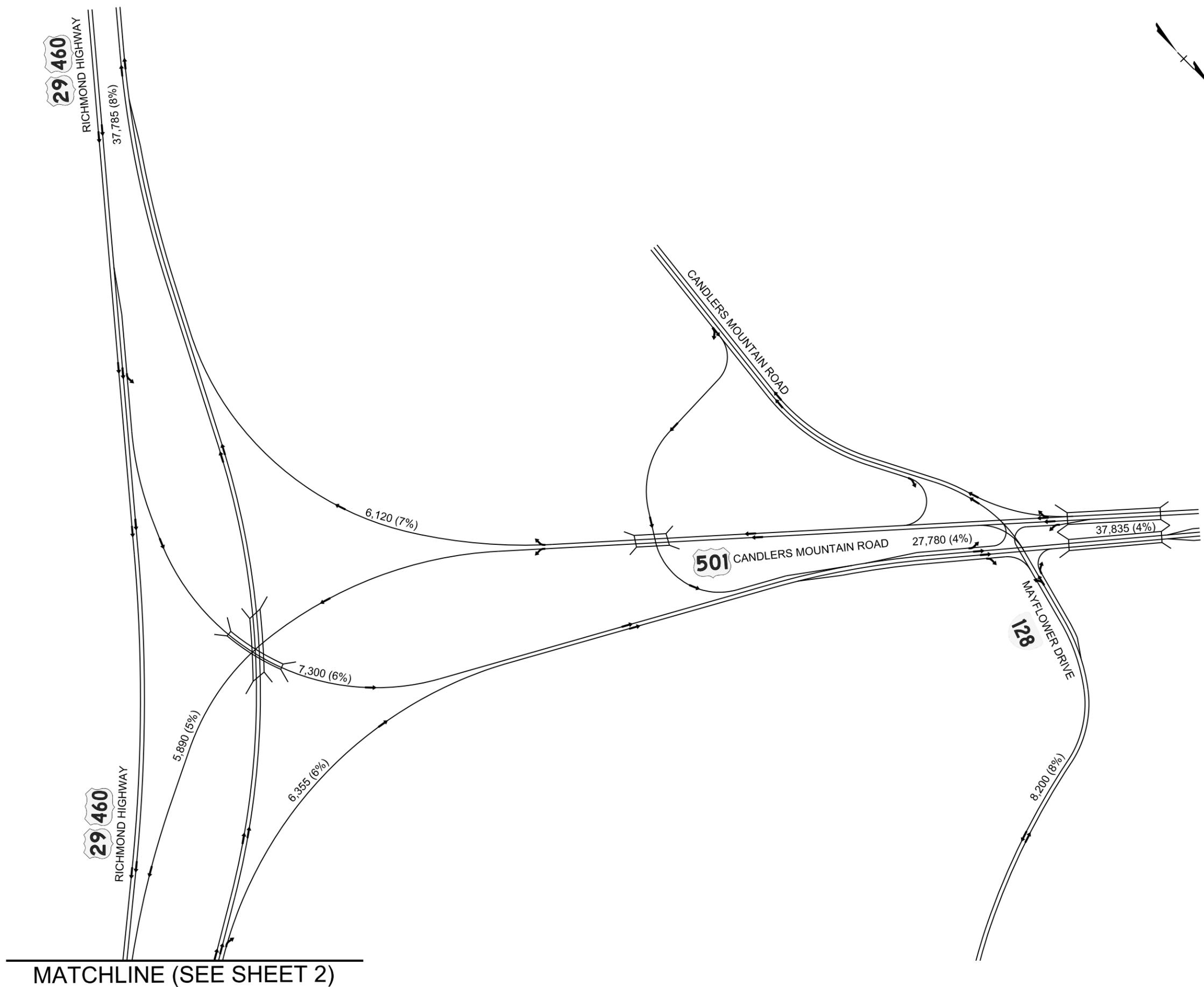


DATE:
DECEMBER 2012

2016 OPENING YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 1 OF 6

LEGEND	
←	Existing Number of Lanes
←	on Roadway Segments
	AADT VOLUME (TRUCK %)

FIGURE
6-5



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

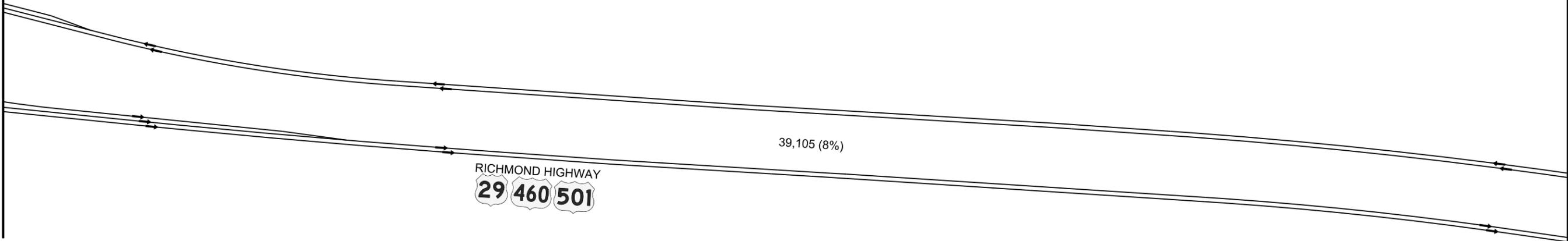
2016 OPENING YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 2 OF 6

LEGEND
← Existing Number of Lanes
← on Roadway Segments
ADT VOLUME (TRUCK %)

FIGURE
6-5



MATCHLINE (SEE SHEET 1)



MATCHLINE (SEE SHEET 3)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

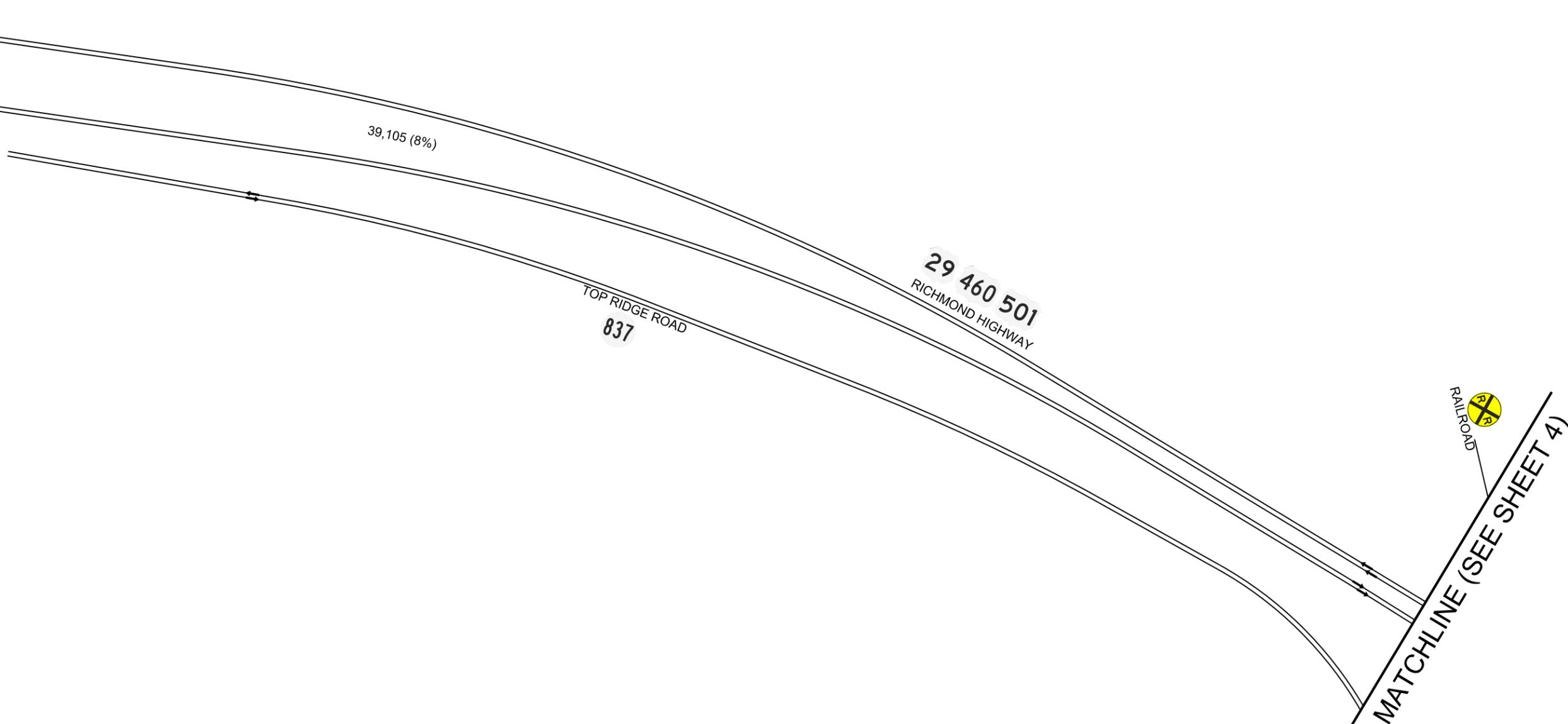
2016 OPENING YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 3 OF 6

LEGEND	FIGURE
← Existing Number of Lanes ← on Roadway Segments	6-5
AADT VOLUME (TRUCK %)	

MATCHLINE (SEE SHEET 6)



MATCHLINE (SEE SHEET 2)



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

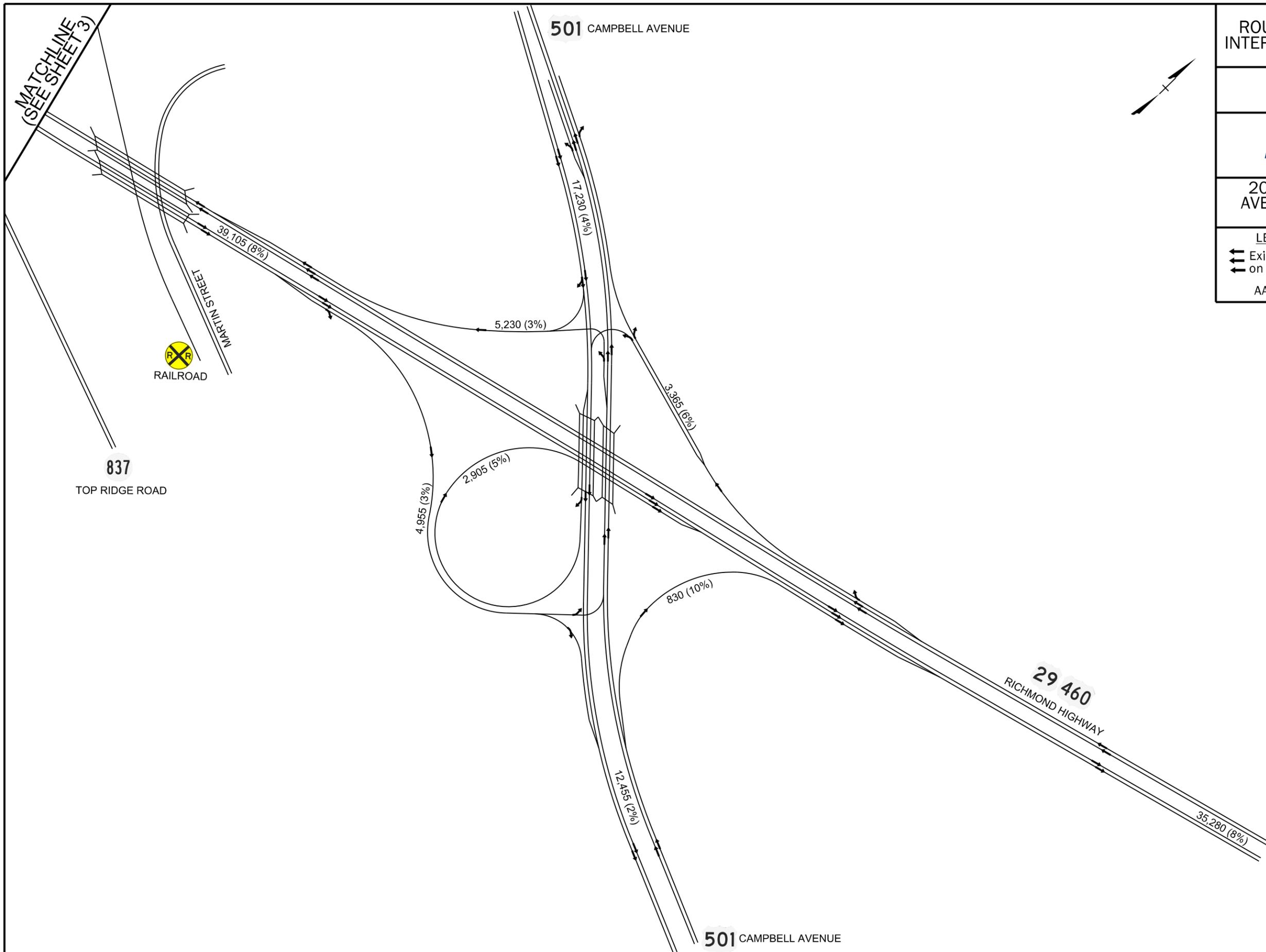


DATE:
DECEMBER 2012

2016 OPENING YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 4 OF 6

LEGEND
 ← Existing Number of Lanes
 ← on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-5



ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 5 OF 6

LEGEND	FIGURE
<ul style="list-style-type: none"> ← Existing Number of Lanes ← on Roadway Segments 	6-5
AADT VOLUME (TRUCK %)	



MATCHLINE (SEE SHEET 6)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

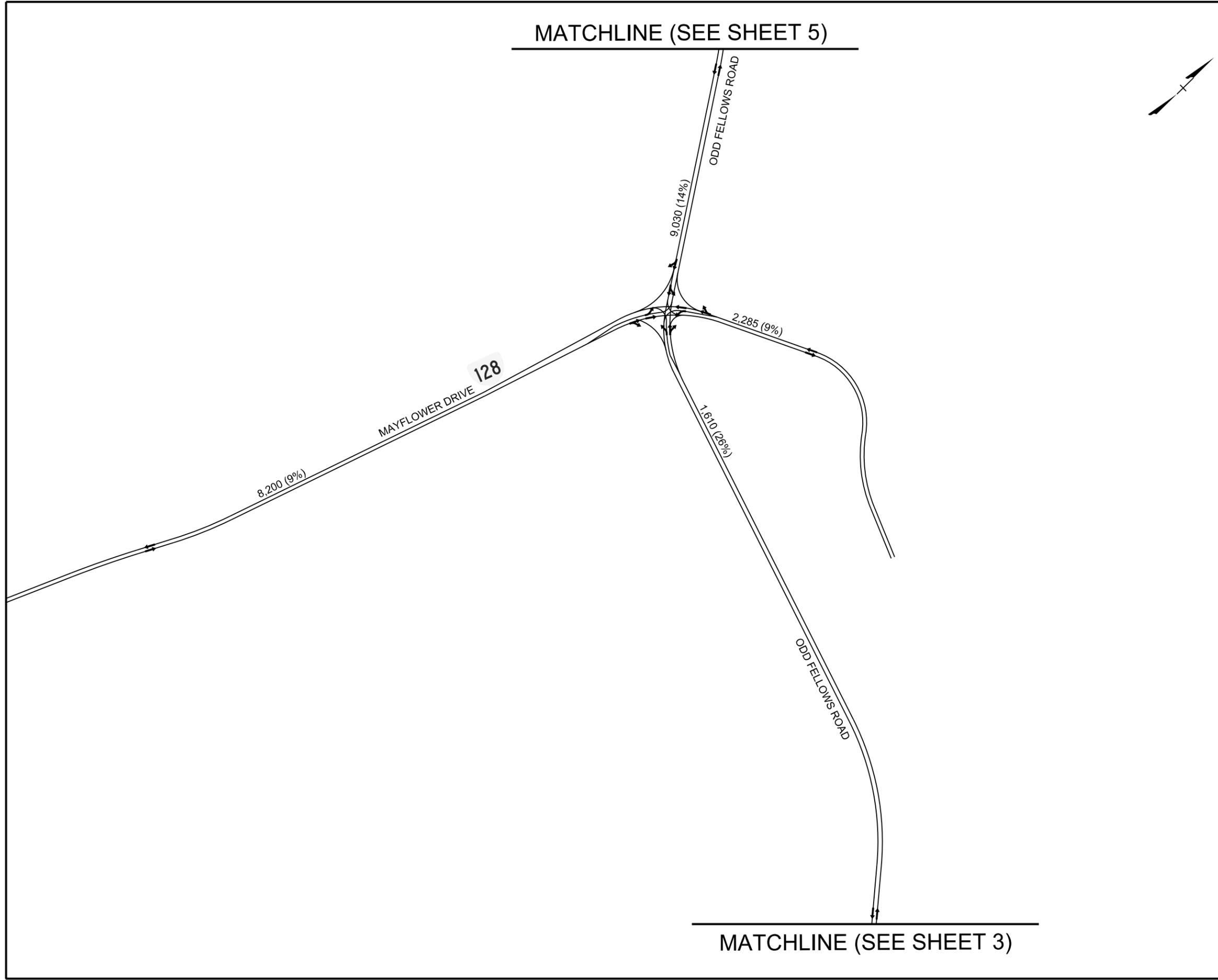


DATE:
DECEMBER 2012

2016 OPENING YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 6 OF 6

LEGEND	
←	Existing Number of Lanes
←	on Roadway Segments
	AADT VOLUME (TRUCK %)

FIGURE
6-5



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

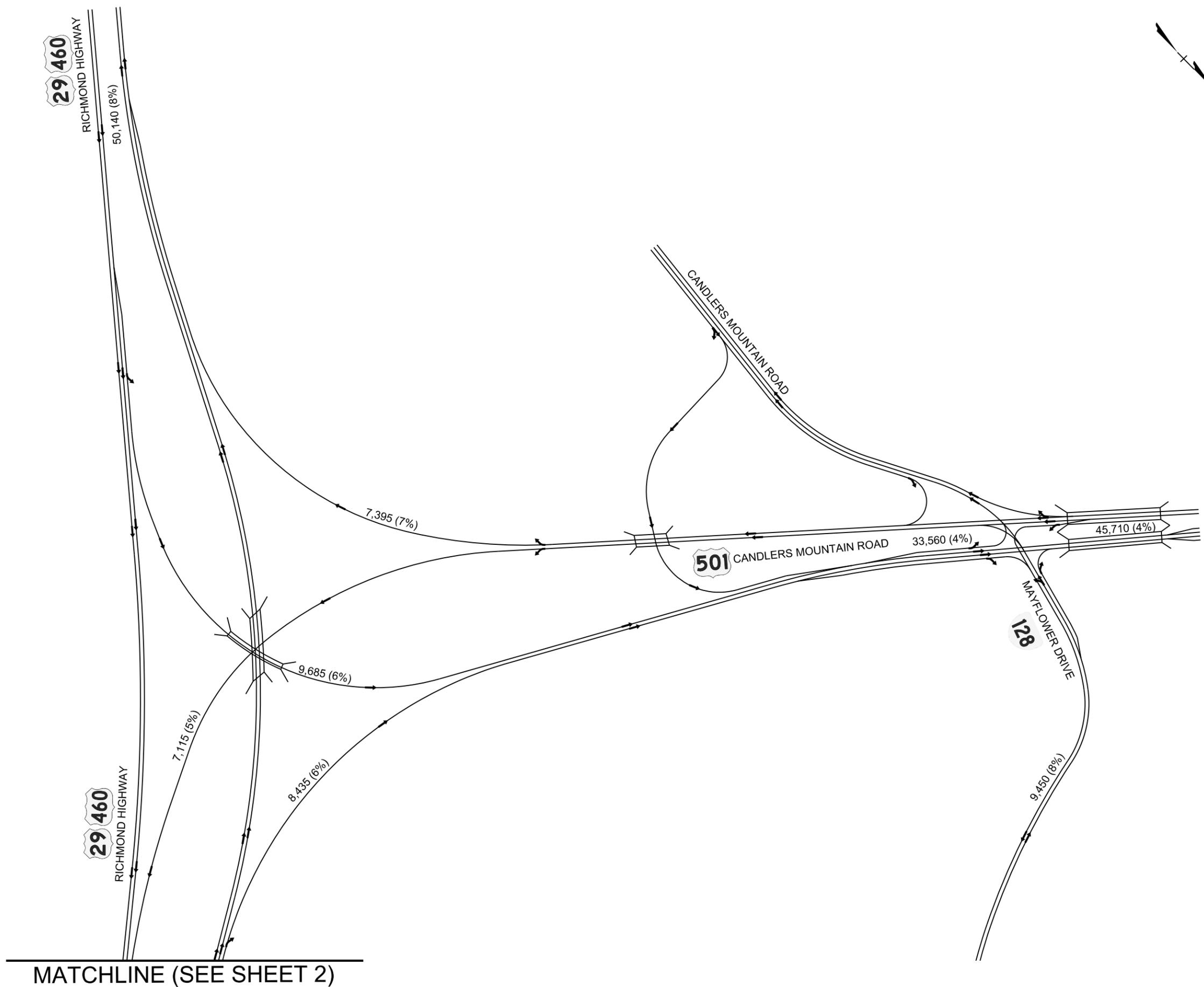


DATE:
DECEMBER 2012

2035 DESIGN YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 1 OF 6

LEGEND	
←	Existing Number of Lanes
←	on Roadway Segments
AADT VOLUME (TRUCK %)	

FIGURE
6-6



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

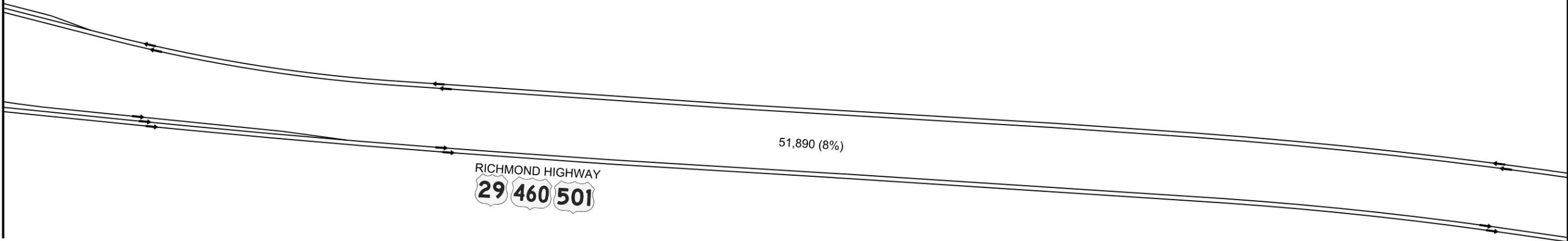
2035 DESIGN YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 2 OF 6

LEGEND
← Existing Number of Lanes
← on Roadway Segments
ADT VOLUME (TRUCK %)

FIGURE
6-6



MATCHLINE (SEE SHEET 1)



MATCHLINE (SEE SHEET 3)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 3 OF 6

LEGEND	FIGURE
← Existing Number of Lanes ← on Roadway Segments	6-6
AADT VOLUME (TRUCK %)	

MATCHLINE (SEE SHEET 6)



MATCHLINE (SEE SHEET 2)



MATCHLINE (SEE SHEET 4)

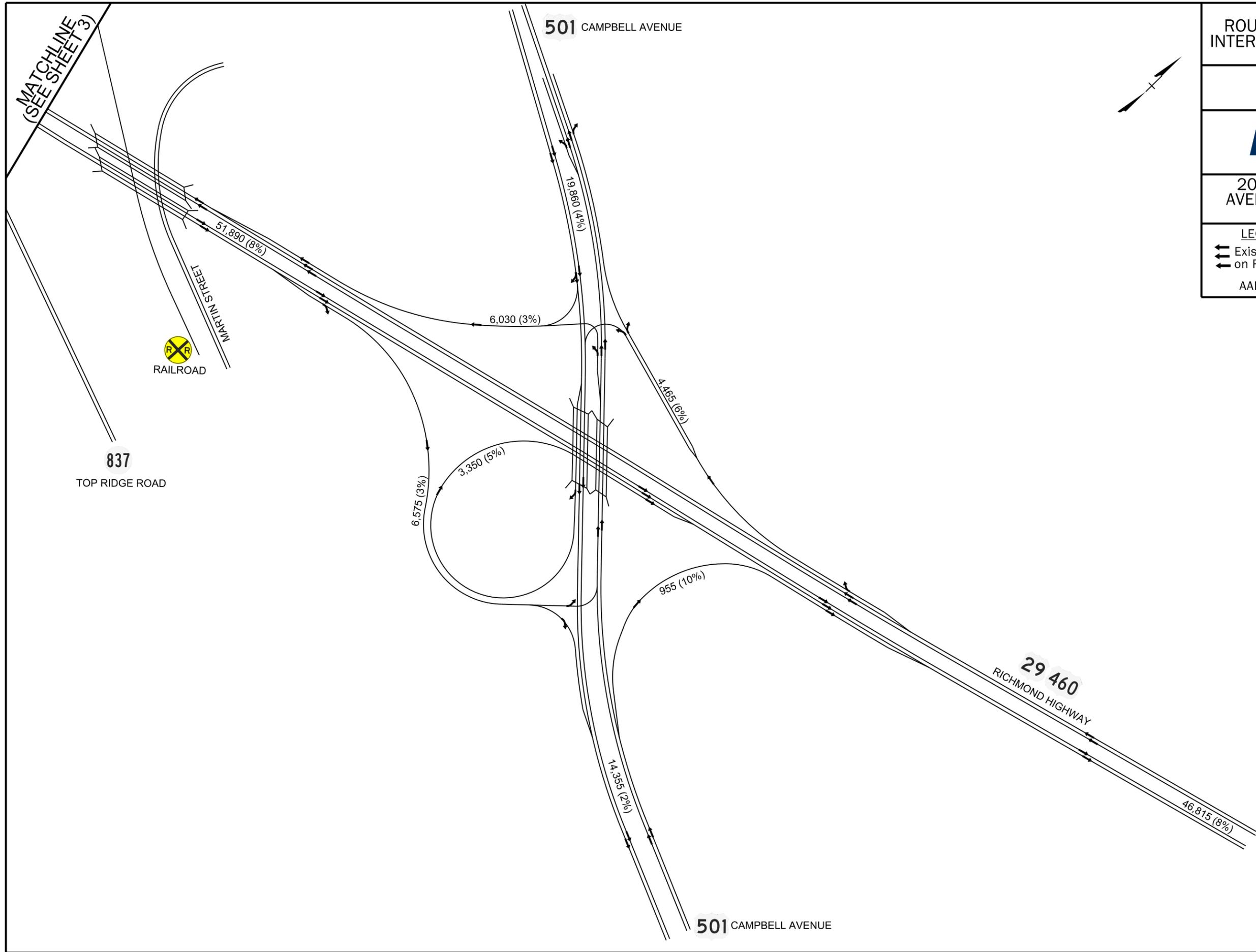
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 4 OF 6

LEGEND	FIGURE
← Existing Number of Lanes ← on Roadway Segments	6-6
AADT VOLUME (TRUCK %)	



ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT

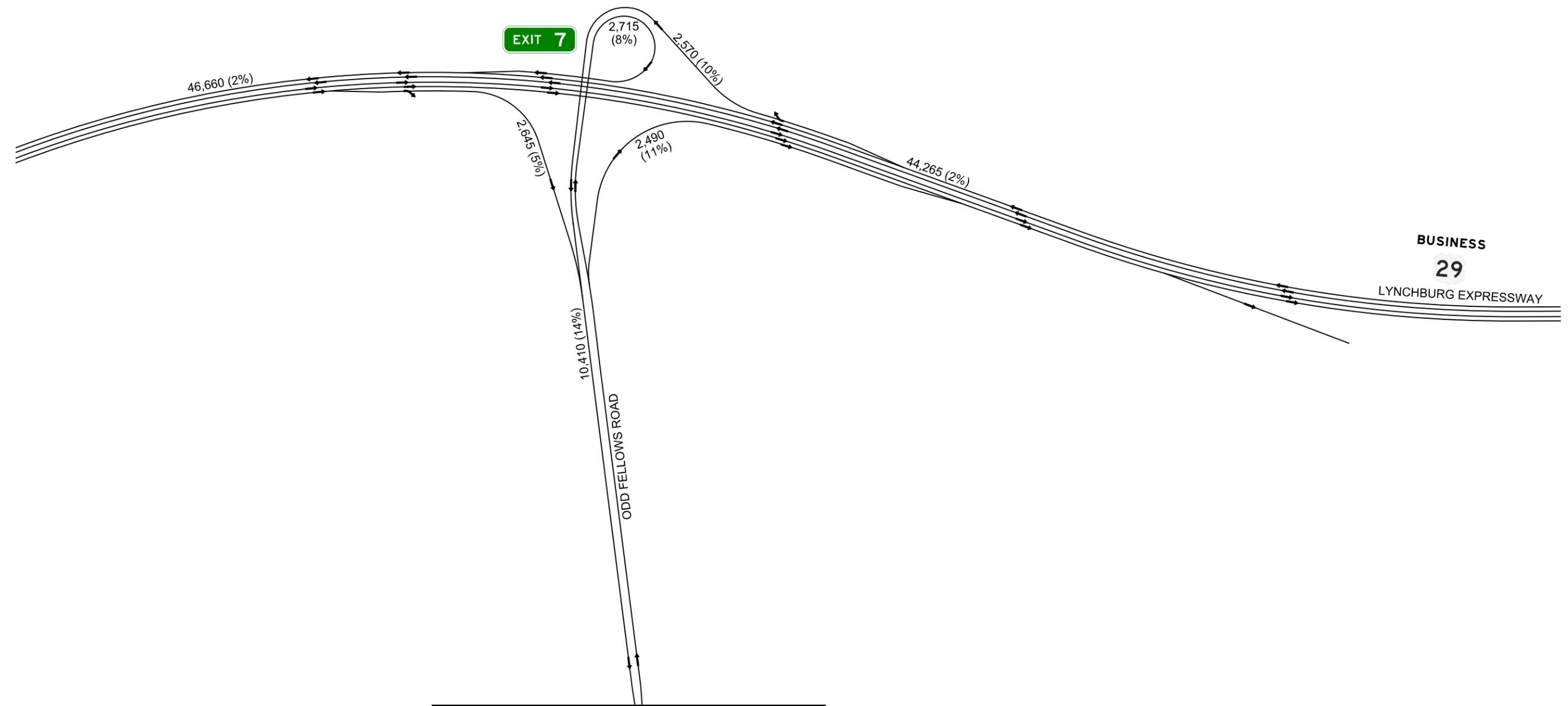


DATE:
DECEMBER 2012

2035 DESIGN YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 5 OF 6

LEGEND	
←	Existing Number of Lanes on Roadway Segments
	AADT VOLUME (TRUCK %)

FIGURE
6-6



MATCHLINE (SEE SHEET 6)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

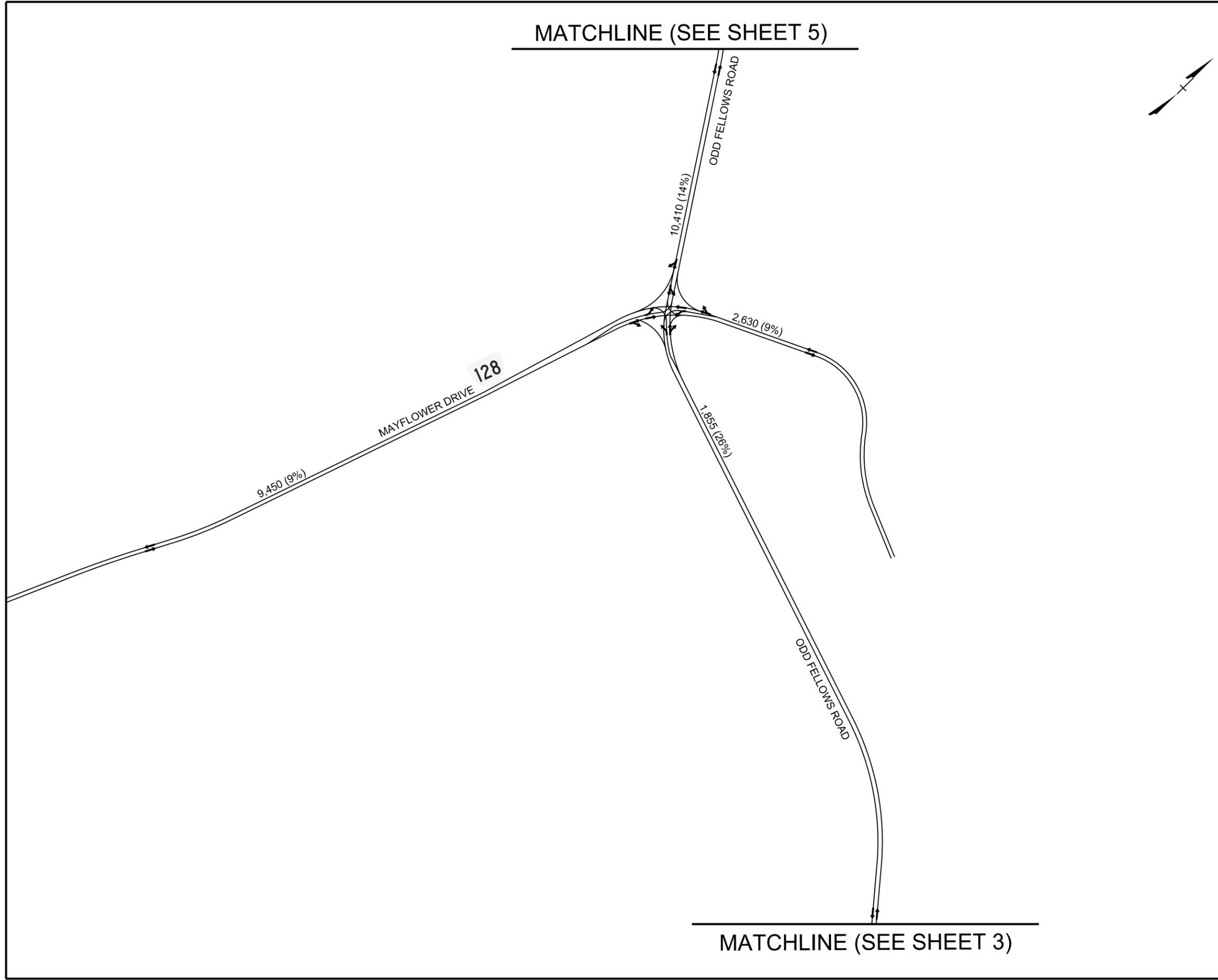


DATE:
DECEMBER 2012

2035 DESIGN YEAR (NO BUILD)
AVERAGE DAILY TRAFFIC VOLUMES
SHEET 6 OF 6

LEGEND	
←	Existing Number of Lanes
←	on Roadway Segments
AADT VOLUME (TRUCK %)	

FIGURE
6-6



MATCHLINE (SEE SHEET 3)

MATCHLINE (SEE SHEET 5)

Whatever the cause of the trend, RK&K did not feel it was appropriate to generate one set of design / peak hour volumes and then reverse them to estimate conditions in the second design / peak hour. Simply reversing the direction of traffic movements from one peak to the other would result in volumes which do not reflect the observed trends in the study area. Instead, RK&K utilized the same link volumes (based on the 10% K-factor) for both the AM and PM design / peak hours and applied independent AM and PM peak directional distributions and turning proportions to generate No Build 2016 and No Build 2035 design / peak hour volumes.

The total future Opening Year (2016) and Design Year (2035) No Build peak hour forecasts are summarized in Figures 6-7 and 6-8. The Opening and Design Year AM and PM peak hour volume No Build forecasts were used in the operational analyses summarized in Chapter 7.

6.3.2. Future Build Forecasts

The basis of the methodology for developing the Opening Year (2016) and Design Year (2035) Build forecasts was to compare the changes in travel patterns (trip assignments) in the “Build” and “No Build” scenario runs of the Lynchburg Area Travel Demand Model (LATDM). The approach used to develop the Build forecasts treated the area bounded by Campbell Avenue to the east, the Lynchburg Expressway (Business Route 29) to the north, Candler Mountain Road to the west, and Route 460 to the south, as a “closed” system. This means that the total traffic entering and exiting the area would remain constant under both the No Build the Build conditions, but traffic would shift between the roadways within the boundary area (including between those roadways forming the edges of the boundary) as appropriate when the new Odd Fellows Road extension and interchange are added to the network. For example, traffic could shift between Mayflower Drive / Candler Mountain Road and Odd Fellows Road to access Route 460; or traffic along the Lynchburg Expressway could shift between the Campbell Avenue and Odd Fellows Road interchanges. Larger, regional shifts in traffic would not be expected due to the proposed Odd Fellows Road interchange; a result which was confirmed by the LATDM model runs.

The forecasting process involved first assigning volumes to the proposed Odd Fellows Road interchange based on the trends observed in the LATDM and then making corresponding adjustments to the volumes utilizing other roadways within the network. The Design Year 2035 No Build AM and PM peak hour forecasts (see Figure 6-6) were used as the starting point and were adjusted based on the proposed Odd Fellows Road extension and interchange with Route 460.

Travel Demand Modeling – Future Build Transportation Network

In order to develop the forecasts for the Build Alternative, the updated version of the LATDM used to determine growth rates for the No Build forecasts was modified by adding the necessary links and nodes along Odd Fellows Road and the appropriate ramp movements for a full-movement interchange along Route 460. After updating the roadway network file, the LATDM model process was run to generate updated trip assignments for the network for the Build Alternative.

Model Observations / Trends

The updated assignment indicated that the proposed interchange would primarily serve as access to the industrial / manufacturing areas located between Candler Mountain Road, Odd Fellows Road, Mayflower Drive, and Route 460. Additionally, some volume of traffic was observed utilizing Odd Fellows Road as a connection between Business Route 29 (Lynchburg Expressway) and Route 460.

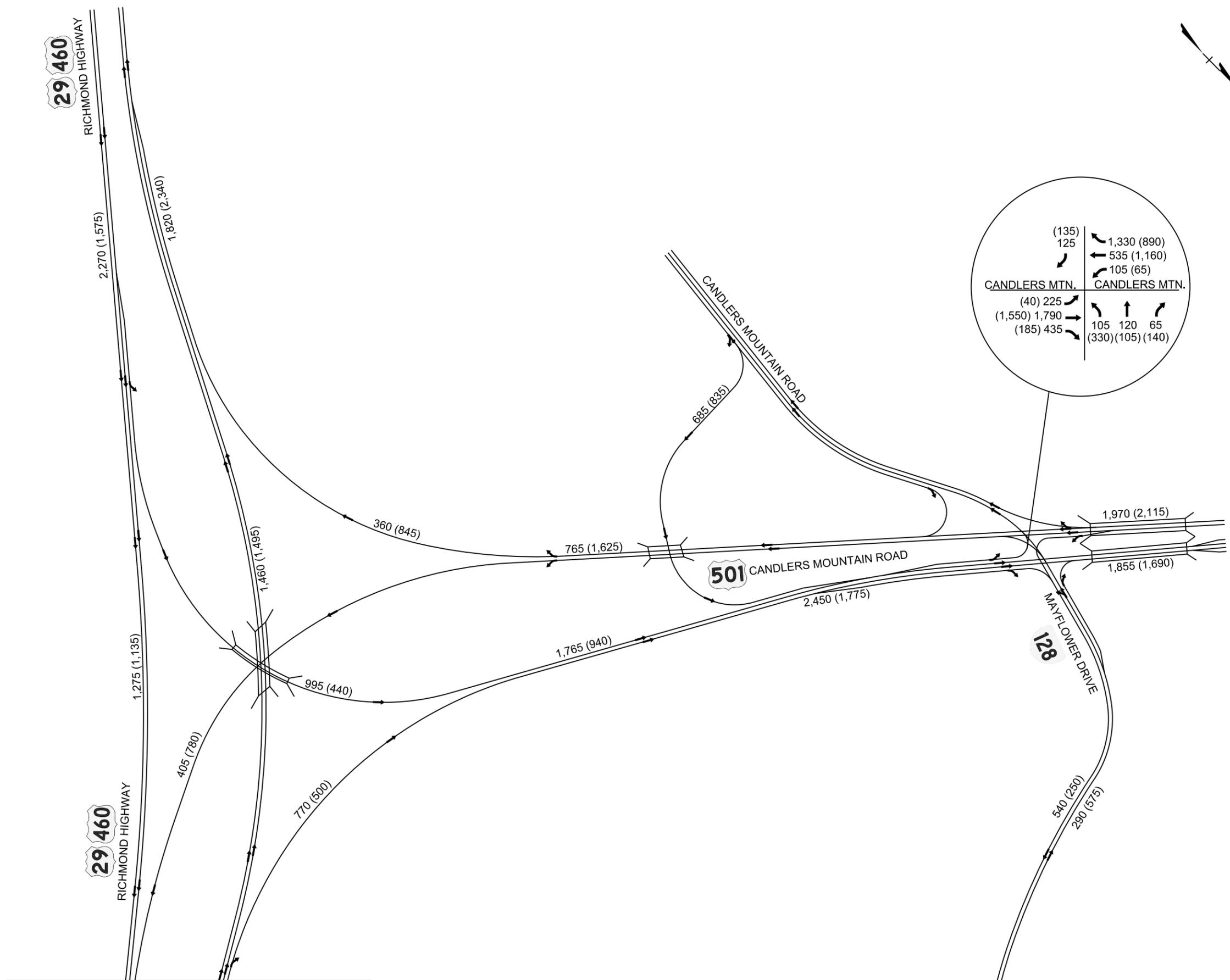
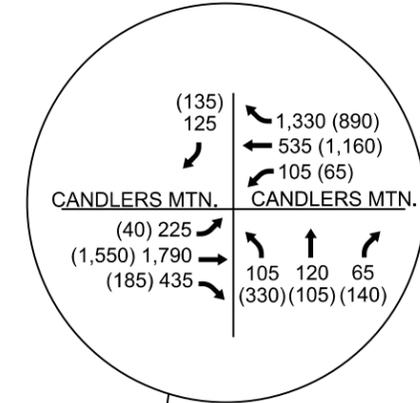
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 1 OF 6

LEGEND	FIGURE
← Existing Number of Lanes	6-7
→ on Roadway Segments	
AADT VOLUME (TRUCK %)	



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 2 OF 6

LEGEND

- ← Existing Number of Lanes
- ← on Roadway Segments
- AADT VOLUME (TRUCK %)

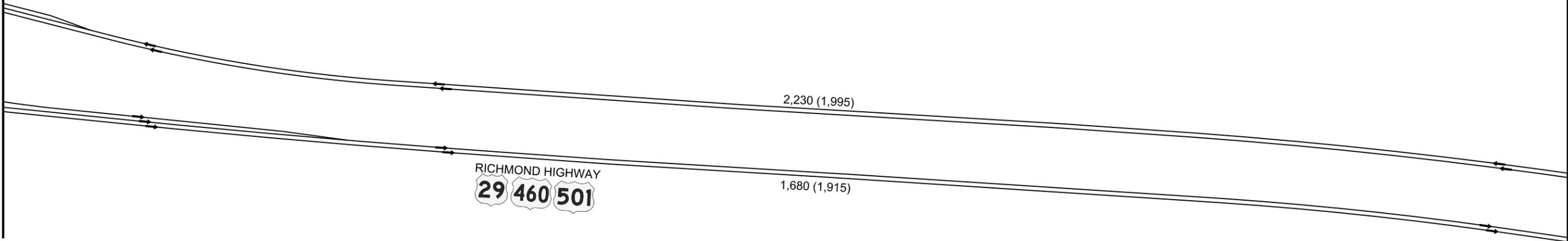
FIGURE

6-7



MATCHLINE (SEE SHEET 1)

MATCHLINE (SEE SHEET 3)



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 3 OF 6

LEGEND

- ← Existing Number of Lanes
- ← on Roadway Segments
- ADT VOLUME (TRUCK %)

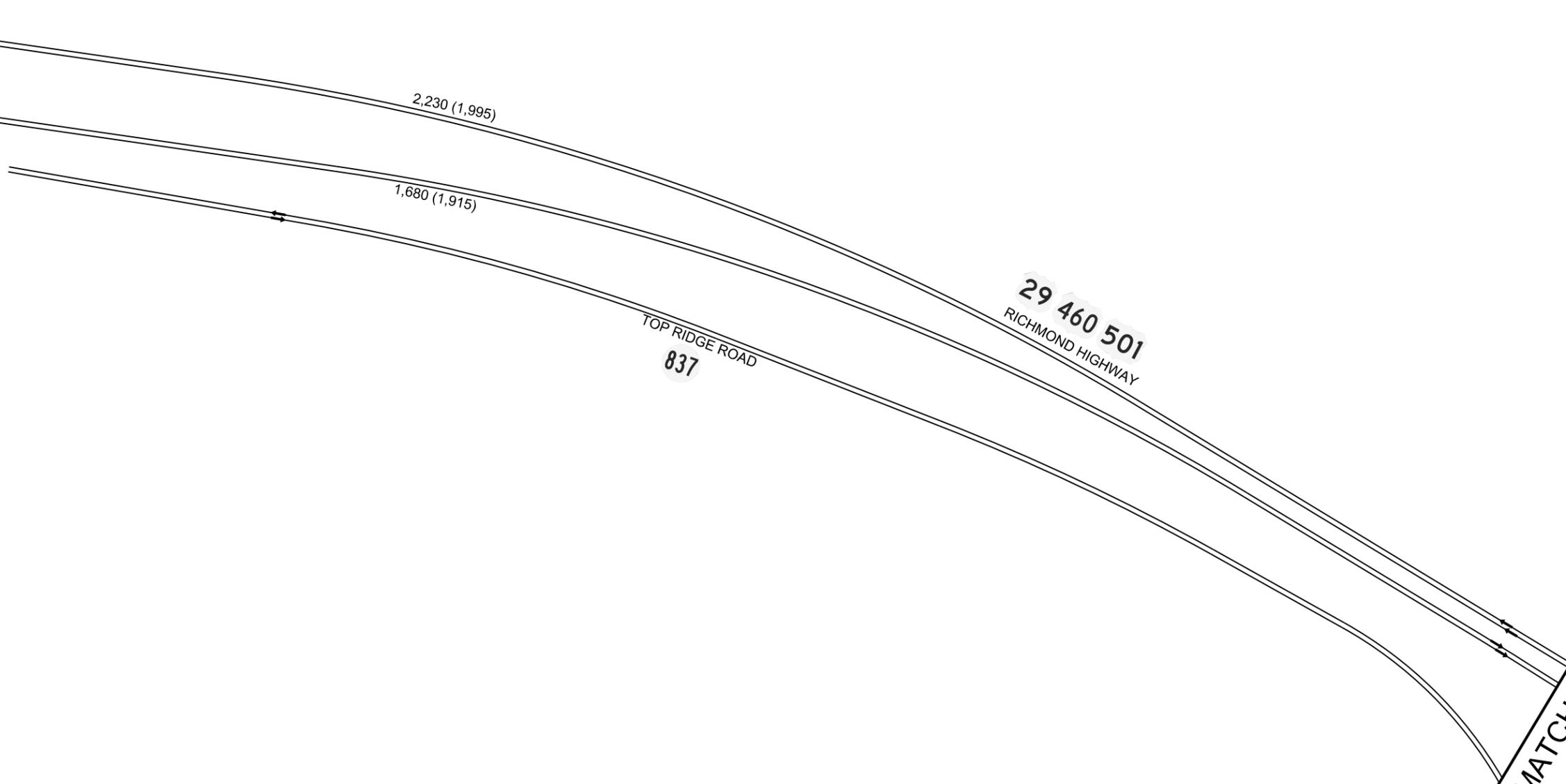
FIGURE

6-7

MATCHLINE (SEE SHEET 6)



MATCHLINE (SEE SHEET 2)



MATCHLINE (SEE SHEET 4)

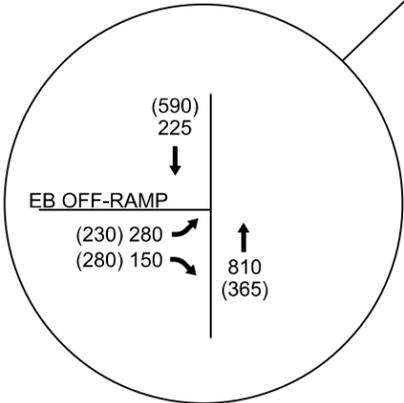
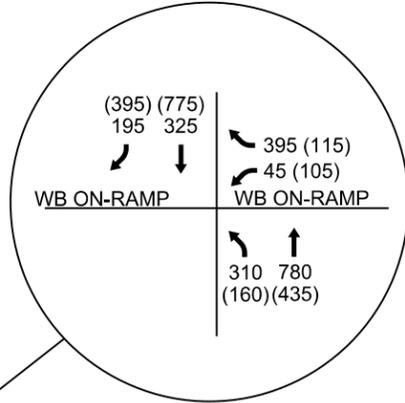
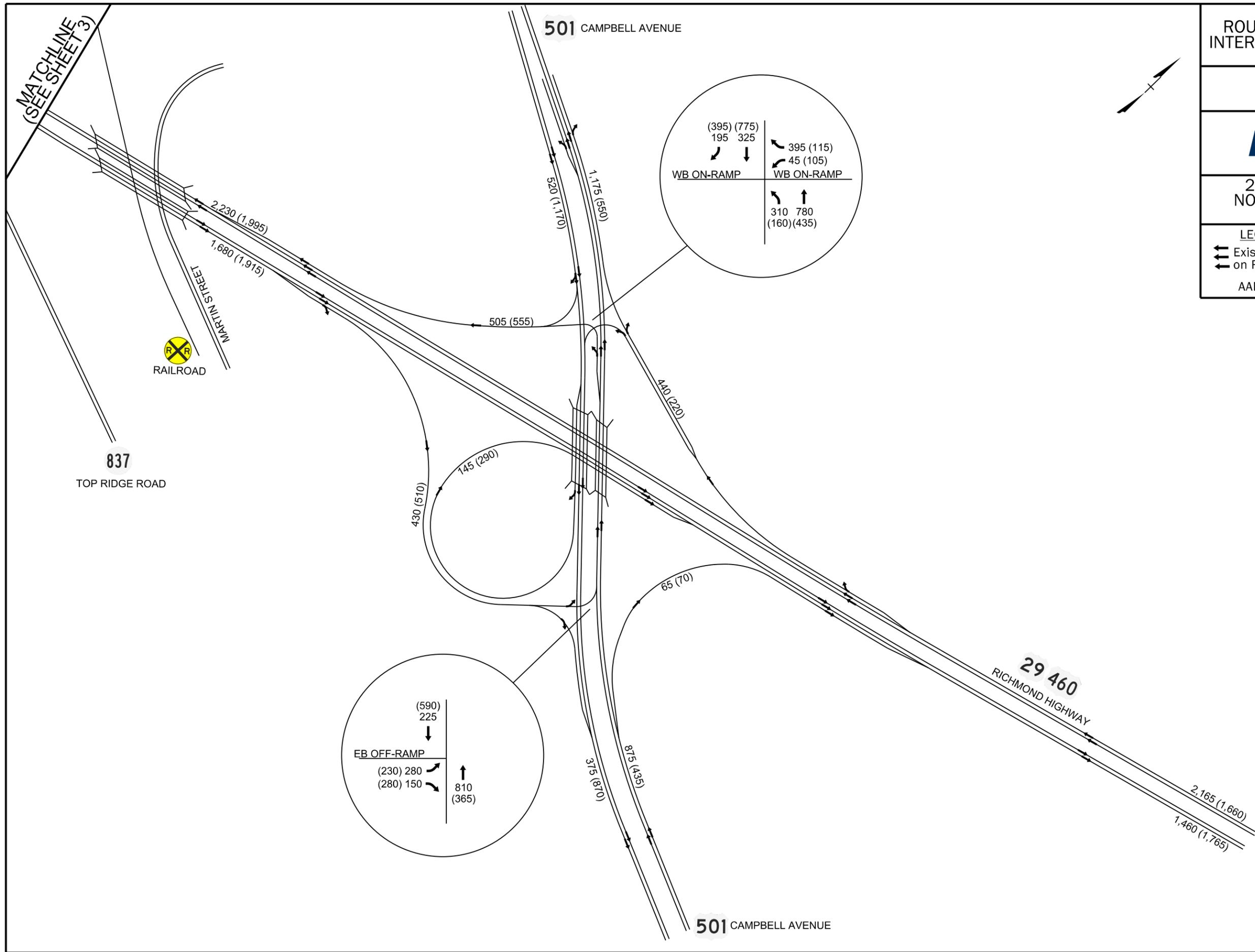
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 4 OF 6

LEGEND	FIGURE
← Existing Number of Lanes ← on Roadway Segments	6-7
AADT VOLUME (TRUCK %)	



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 5 OF 6

LEGEND
 ← Existing Number of Lanes
 ← on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-7



MATCHLINE (SEE SHEET 6)

ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT

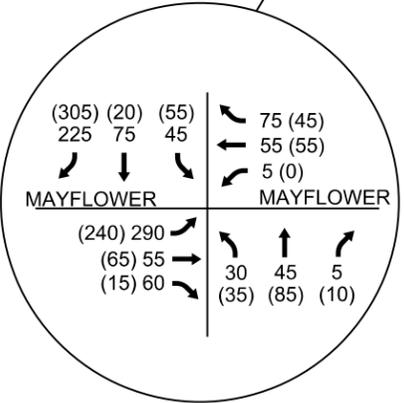
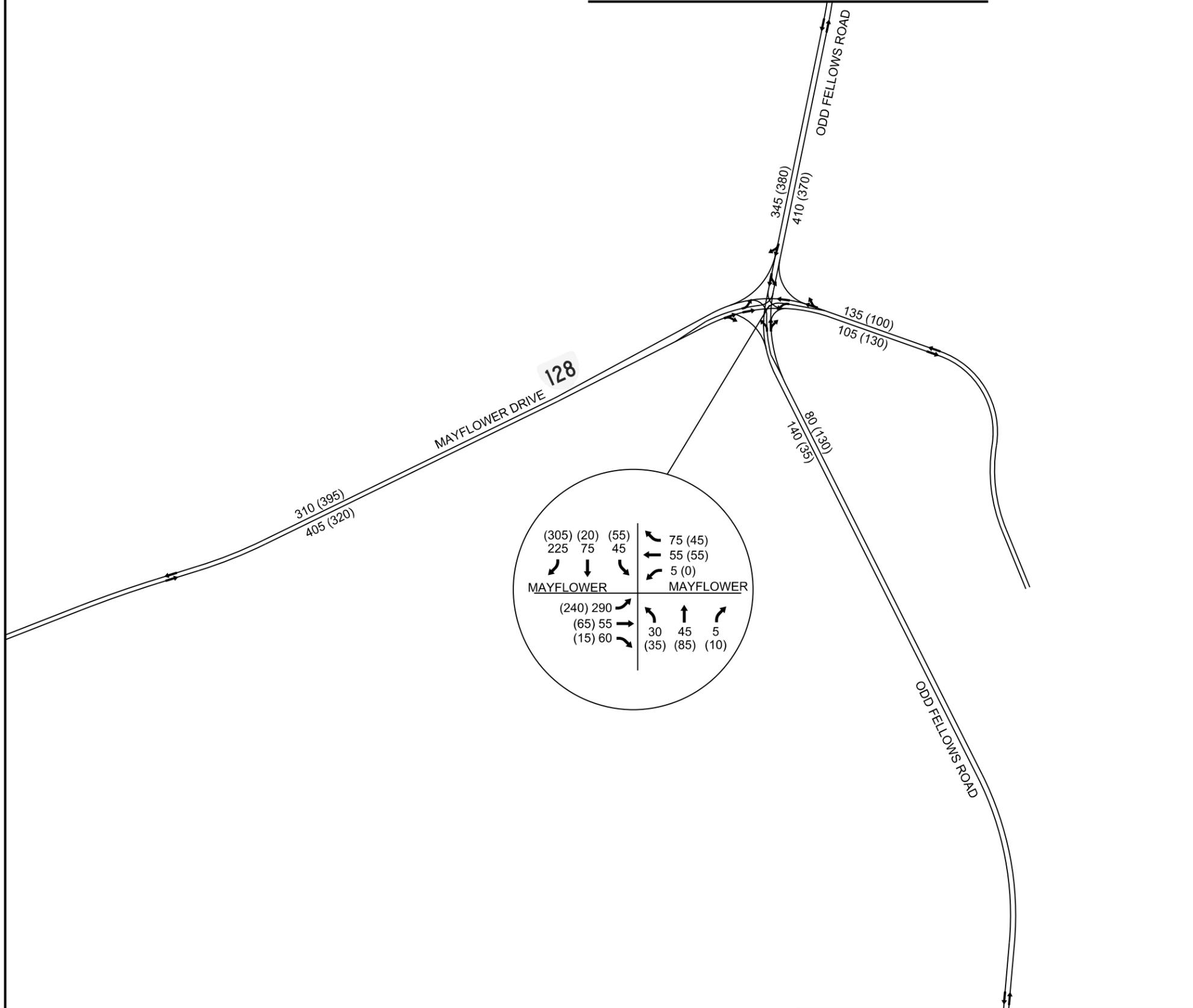


DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 6 OF 6

LEGEND	FIGURE
Existing Number of Lanes on Roadway Segments AADT VOLUME (TRUCK %)	6-7

MATCHLINE (SEE SHEET 5)



MATCHLINE (SEE SHEET 3)

ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT

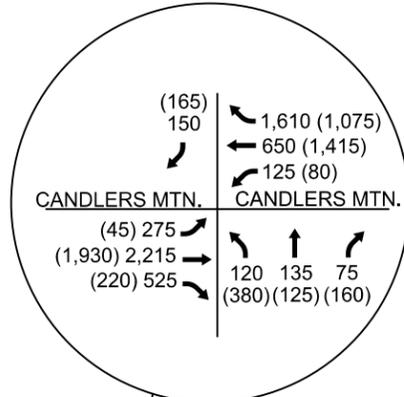
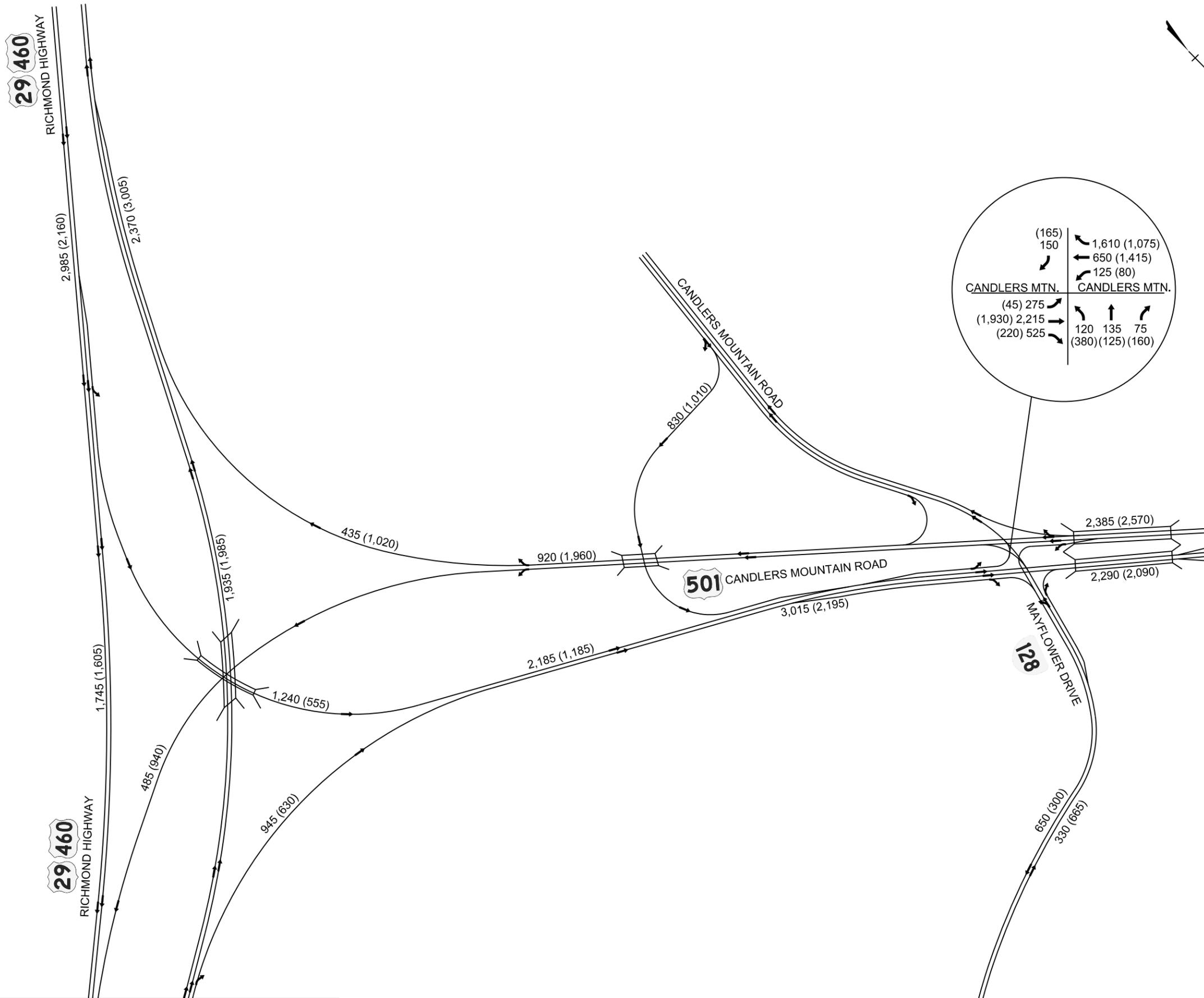


DATE:
DECEMBER 2012

2035 DESIGN YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 1 OF 6

LEGEND
 ← Existing Number of Lanes
 → on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-8



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

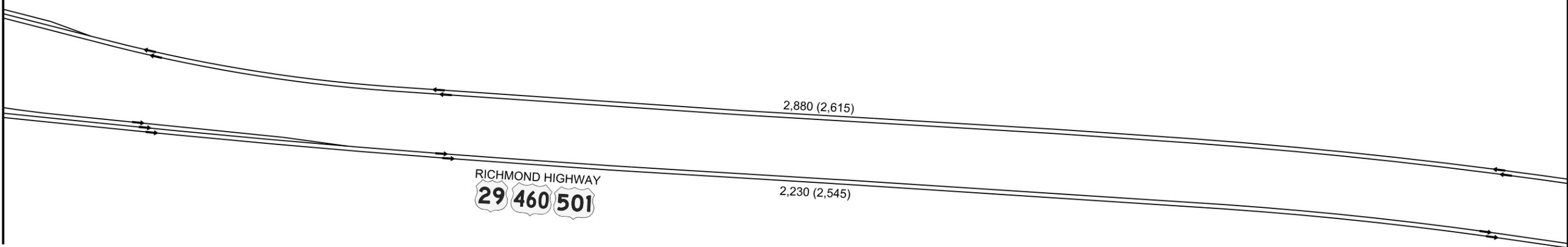
2035 DESIGN YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 2 OF 6

LEGEND
← Existing Number of Lanes
← on Roadway Segments
AADT VOLUME (TRUCK %)

FIGURE
6-8



MATCHLINE (SEE SHEET 1)



MATCHLINE (SEE SHEET 3)

ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 3 OF 6

LEGEND

- ← Existing Number of Lanes
- ← on Roadway Segments
- ADT VOLUME (TRUCK %)

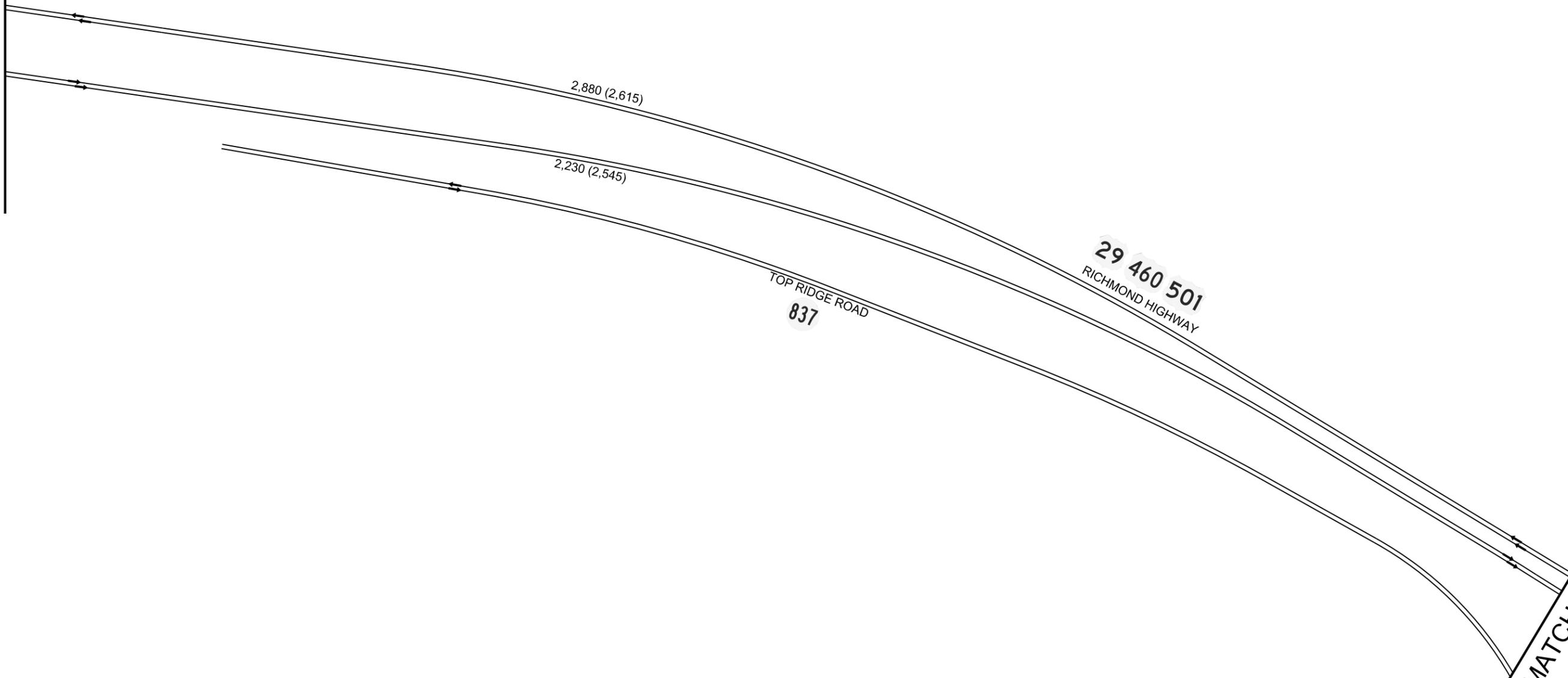
FIGURE

6-8

MATCHLINE (SEE SHEET 6)



MATCHLINE (SEE SHEET 2)



MATCHLINE (SEE SHEET 4)

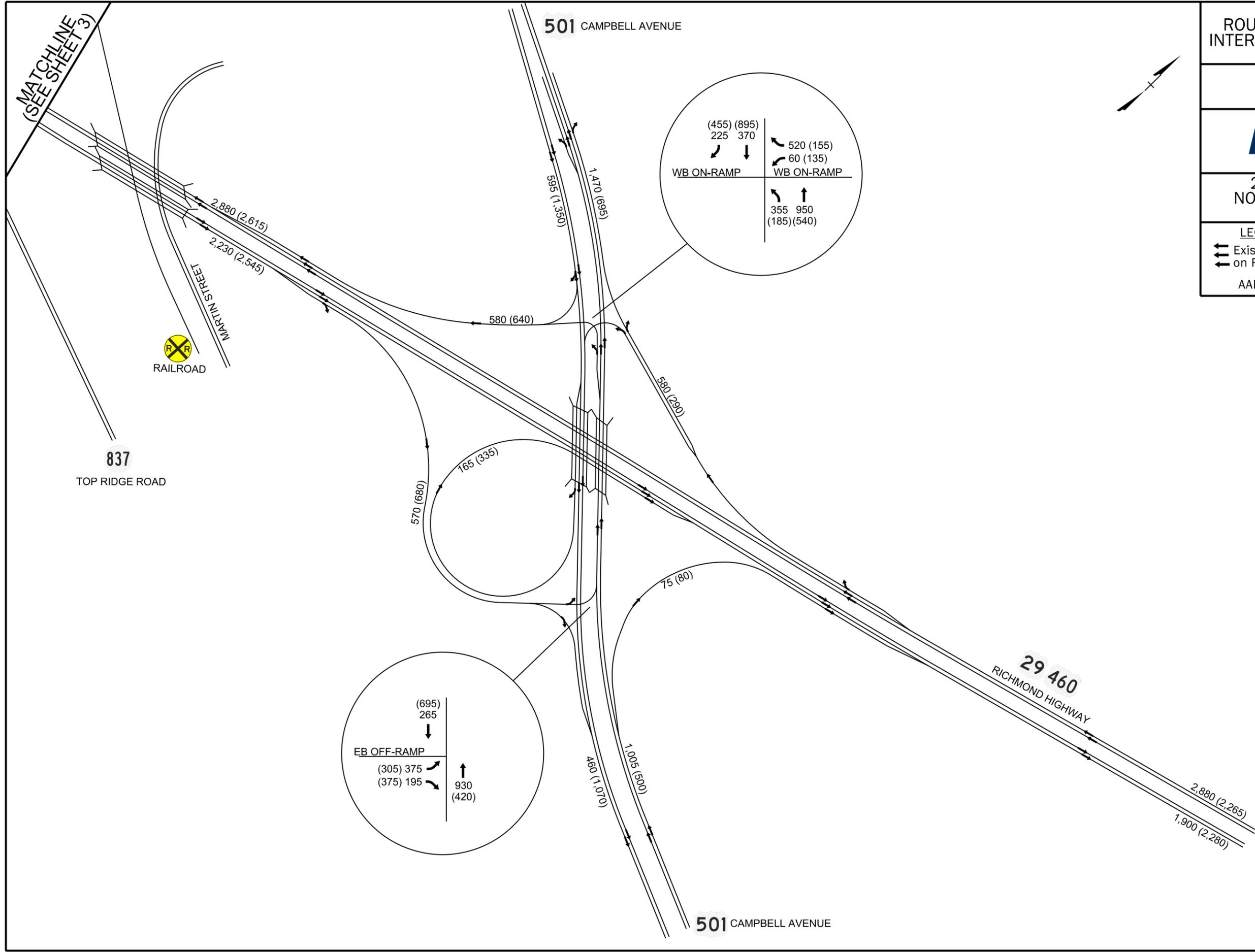
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 4 OF 6

LEGEND	FIGURE
← Existing Number of Lanes ← on Roadway Segments	6-8
AADT VOLUME (TRUCK %)	



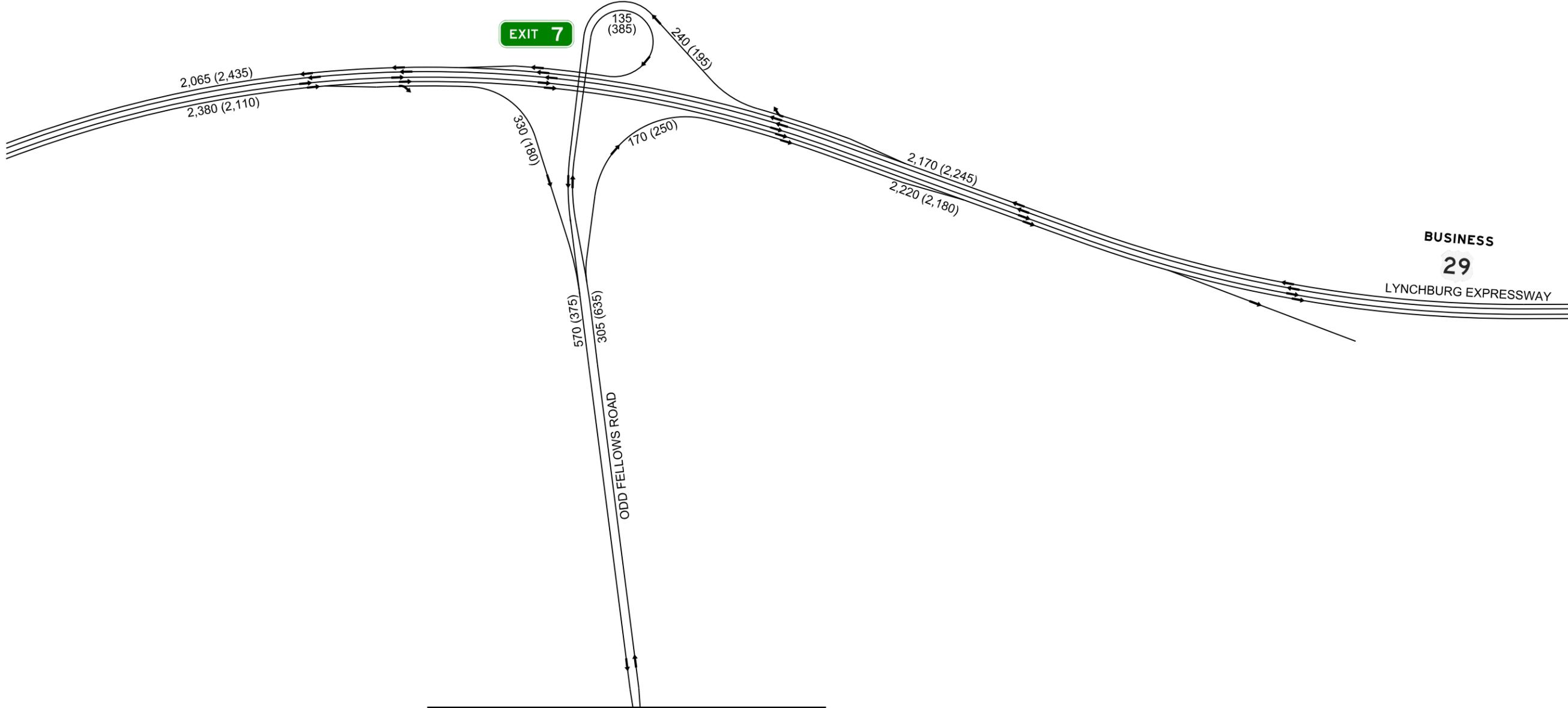
ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 5 OF 6

LEGEND	FIGURE
<ul style="list-style-type: none"> ← Existing Number of Lanes ← on Roadway Segments 	6-8
AADT VOLUME (TRUCK %)	



MATCHLINE (SEE SHEET 6)

ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

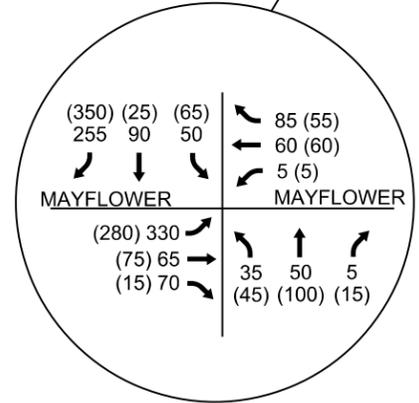
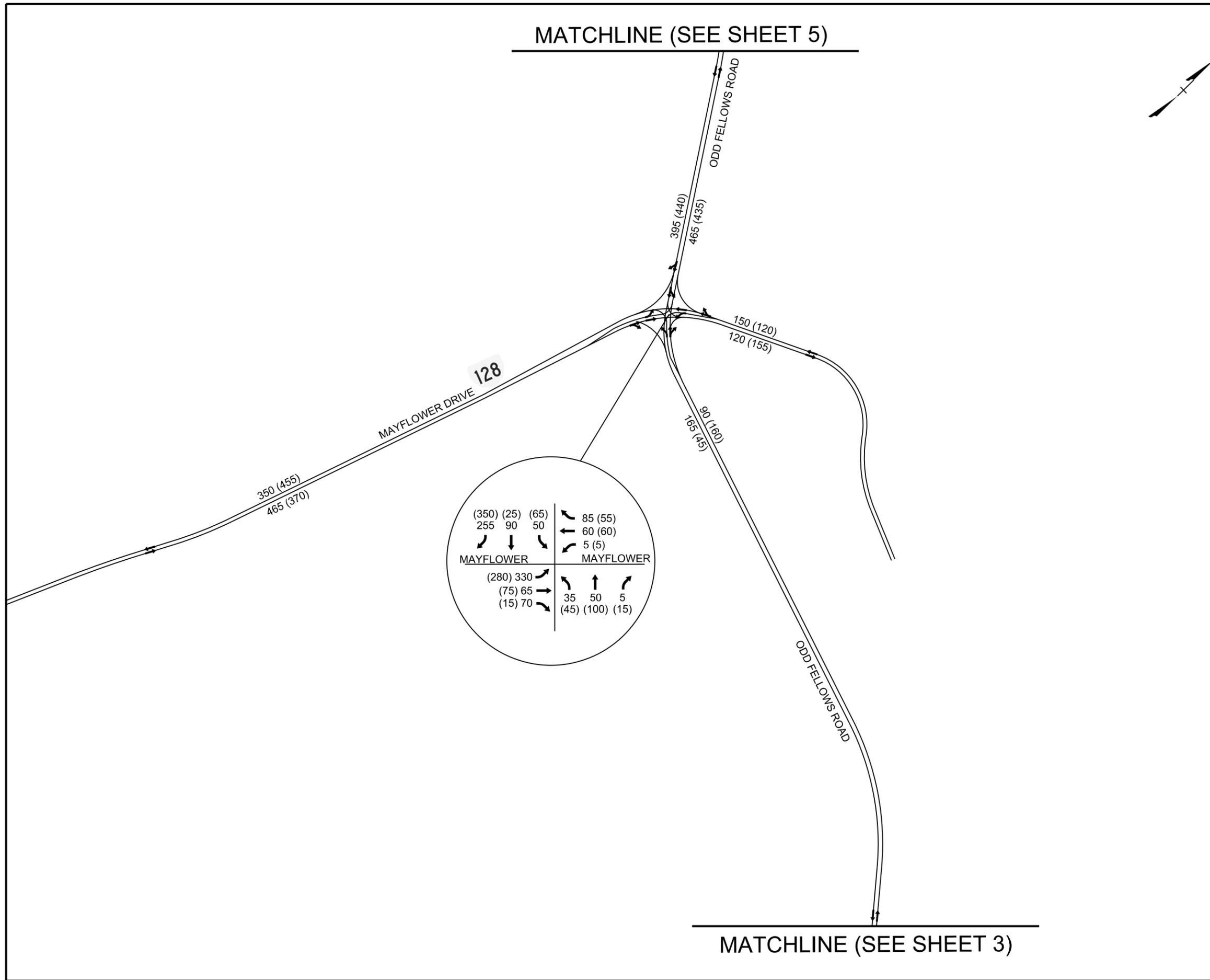
2035 DESIGN YEAR AM(PM)
NO BUILD PEAK HOUR VOLUMES
SHEET 6 OF 6

LEGEND

- ← Existing Number of Lanes
- ← on Roadway Segments
- AADT VOLUME (TRUCK %)

FIGURE

6-8



Overall, there was a net reduction in traffic along Candler's Mountain Road of approximately 8 to 10 percent. This result was expected given the location of the primary traffic generators (River Ridge Mall and Liberty University) within the Study Area; both have access points along Candler's Mountain Road. In total, the TAZs within the Study Area bordering the Candler's Mountain Road area generate approximately 85,000 trips per day in Design Year 2035. The model results indicate that the proposed interchange would offer minimal travel time savings to motorists accessing these major generators, particularly from points east of the study area along Route 460. This traffic would be required to exit at Odd Fellows Road, make a left onto Mayflower Road and then travel to Candler's Mountain Road to access these sites via the new interchange. Additionally, there does also appear to be a small "back-fill" affect along Candler's Mountain Road, where some traffic is shifting from adjacent (also congested) routes, such as Wards Road, to make use of any capacity freed up along Candler's Mountain by the Odd Fellows Road extension and interchange with Route 460. Therefore, the initial shift away from Candler's Mountain Road may be greater than 10% of the traffic volume, but other traffic then makes use of a portion of the available capacity.

Build Design / Peak Hour Traffic Volumes

Based on the trends observed within the model and accounting for potential growth in traffic due to the preliminary development concept shown in Liberty University's preliminary Master Plan for the area south of Route 460, Opening Year (2016) and Design Year (2035) Build AM and PM Peak Hour volumes for the Build Alternative were developed.

Changes in the LATDM traffic assignment between the "No Build" and "Build" model scenarios were calculated in terms of percentages. Using these percentages and the 2035 No Build AM and PM peak hour forecast volumes as a starting point, trips were reassigned from existing facilities to the proposed new roadway links, including Odd Fellows Road Extended and the ramps at the Odd Fellows Road / Route 460 interchange. The traffic shifts for specific movements during the peak periods typically ranged from 25 to 100 vehicles.

Next, using the preliminary concept plan for the development area south of the interchange provided by Liberty University; trip generation, using standard ITE Trip Generation (8th Edition) methodology, was conducted. Table 6-6 summarizes the trip generation for the major elements of this potential additional development south of Route 460.

Table 6-6. Trip Generation for the Preliminary Liberty University Development Plan

Proposed Land Type	ITE Code Utilized	# Units	Independent Variable	Daily Trips	Weekday AM Peak Hour Total Traffic	Directional Distribution		Weekday PM Peak Hour Total Traffic	Directional Distribution	
						Enter	Exit		Enter	Exit
Hotel	311	150	Rooms	735	57	31	26	60	27	33
Shopping Center	820	26,500	Sq. Feet of leasable area	1,138	71	43	28	86	52	34
Sit Down Restaurant	932	7,875	Sq. Feet of floor area	1,001	91	47	44	187	97	90
Gas / Service Station	945	3,000	Sq. Feet of floor area	1,488	233	119	114	261	125	136
Fast Food Restaurant	934	5,400	Sq. Feet of floor area	2,679	287	146	141	289	144	145
Total				7,041	789	386	353	883	445	438

The total daily trip generation projected for the preliminary concept plan development is generally consistent with the future traffic growth projected in the model for the TAZ south of Route 460 and east of Candler's Mountain Road. The AM and PM peak hour trips in Table 6-6 were then assigned to the network based on the observed trip distribution within the model. These potential development trips were added to the "shifted" Build 2016 and 2035 AM and PM peak hour volumes (developed using the trends observed within the regional model). The combined volumes represent the total projected traffic at the proposed Odd Fellows Road / Route 460 interchange for the Build Alternative. The Opening Year (2016) and Design Year (2035) Average Daily Traffic volumes are summarized in Figures 6-9 and 6-10. The Opening Year (2016) and Design Year (2035) AM and PM peak hour volumes are summarized in Figure 6-11 and 6-12. Figure 6-13 shows the comparison in the 2035 Build and No Build volumes and which volumes are expected to increase and decrease based on the proposed interchange.

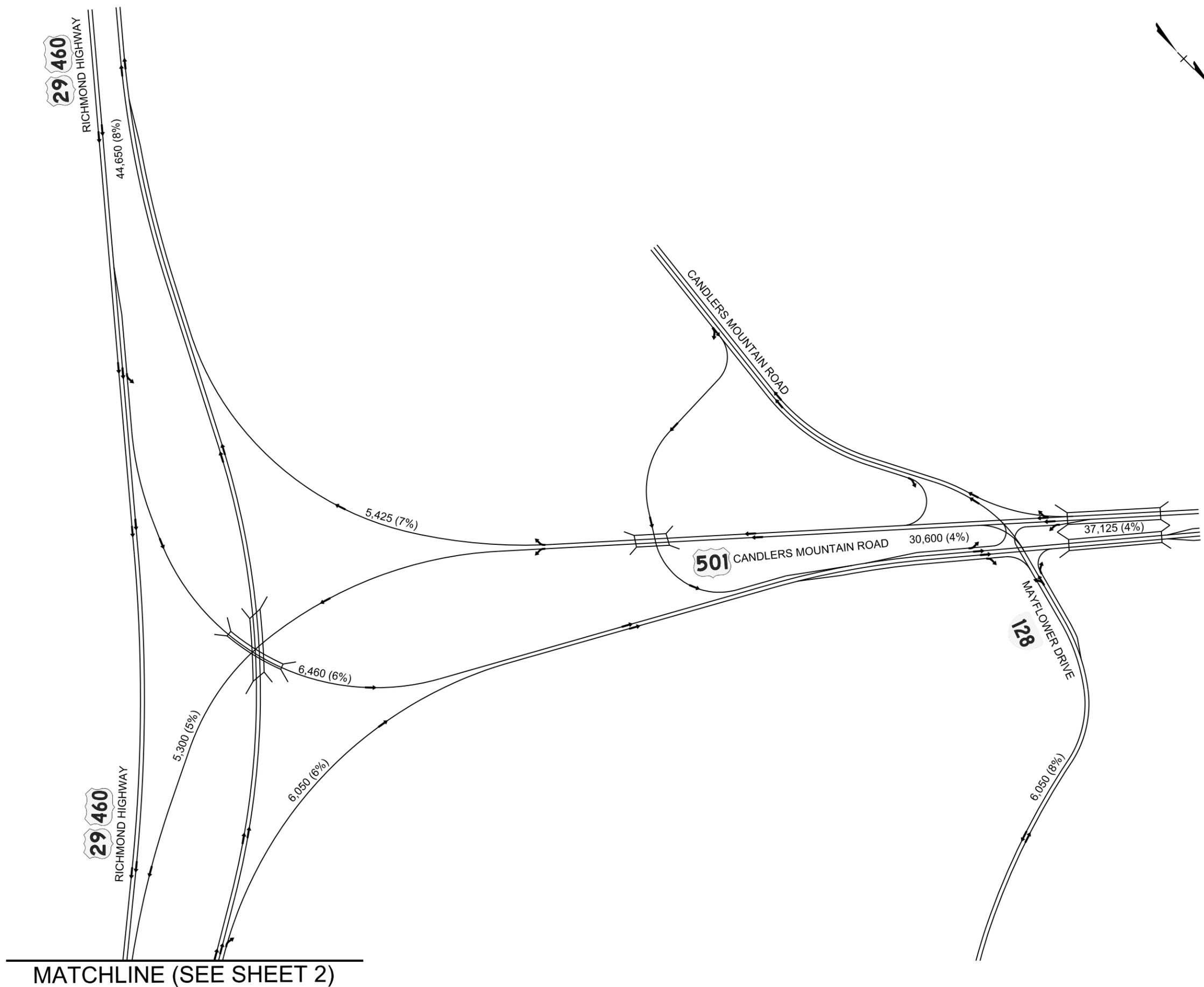
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 1 OF 6

LEGEND		FIGURE
←	Existing Number of Lanes	6-9
←	on Roadway Segments	
AADT VOLUME (TRUCK %)		



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 2 OF 6

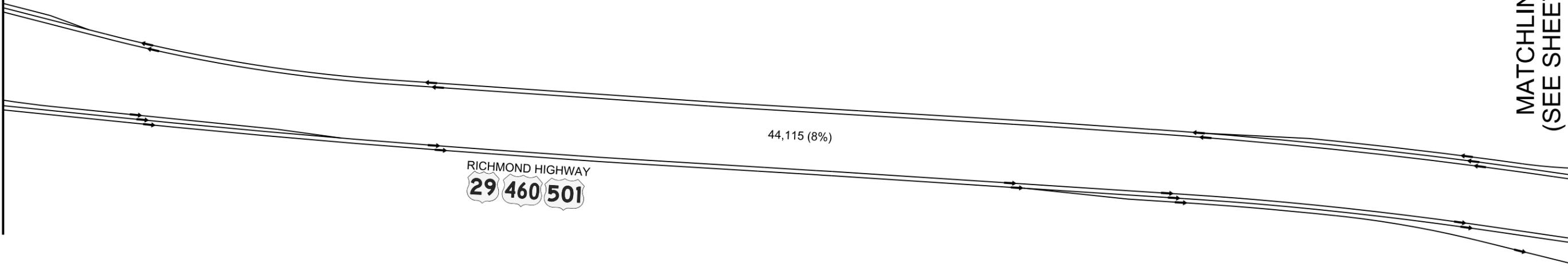
LEGEND
← Existing Number of Lanes
← on Roadway Segments
AADT VOLUME (TRUCK %)

FIGURE
6-9



MATCHLINE (SEE SHEET 1)

MATCHLINE
(SEE SHEET 3)



RICHMOND HIGHWAY
29 460 501

ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 3 OF 6

LEGEND

- ← Existing Number of Lanes
- ← on Roadway Segments
- AADT VOLUME (TRUCK %)

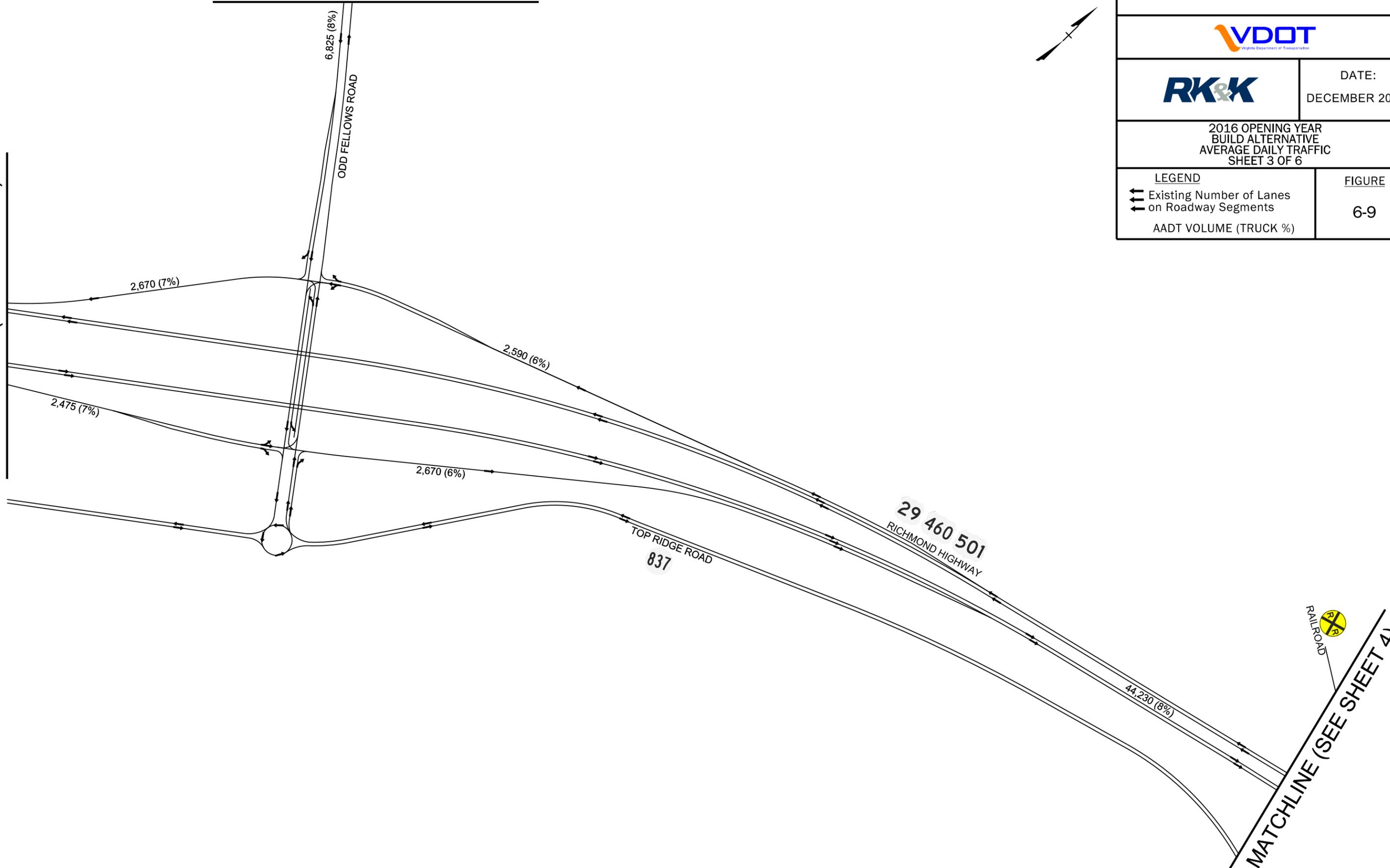
FIGURE

6-9

MATCHLINE (SEE SHEET 6)



MATCHLINE (SEE SHEET 2)



MATCHLINE (SEE SHEET 4)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

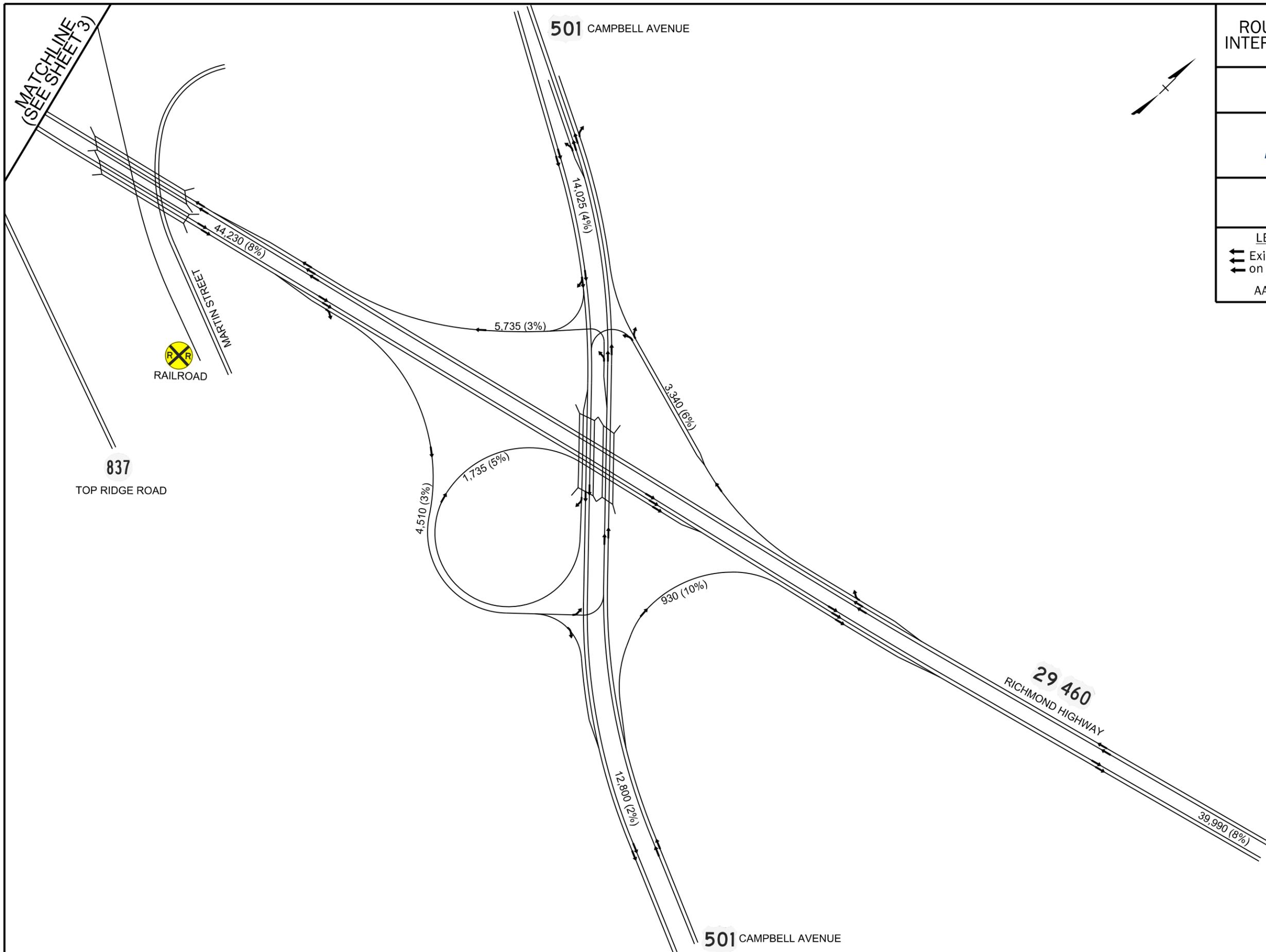


DATE:
DECEMBER 2012

2016 OPENING YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 4 OF 6

LEGEND
 ← Existing Number of Lanes
 ← on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-9



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

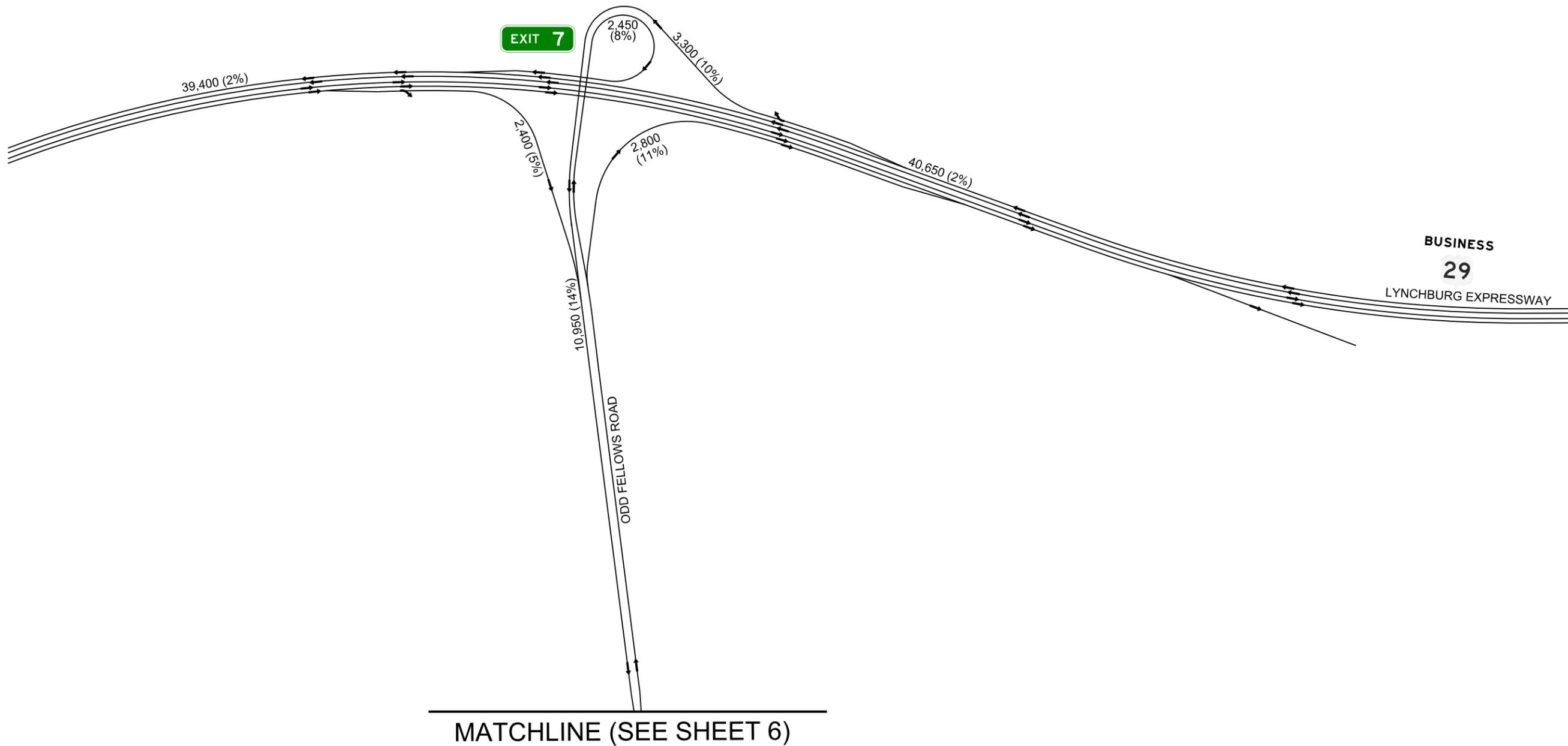
2016 OPENING YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 5 OF 6

LEGEND

- ← Existing Number of Lanes
- ← on Roadway Segments
- AADT VOLUME (TRUCK %)

FIGURE

6-9



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

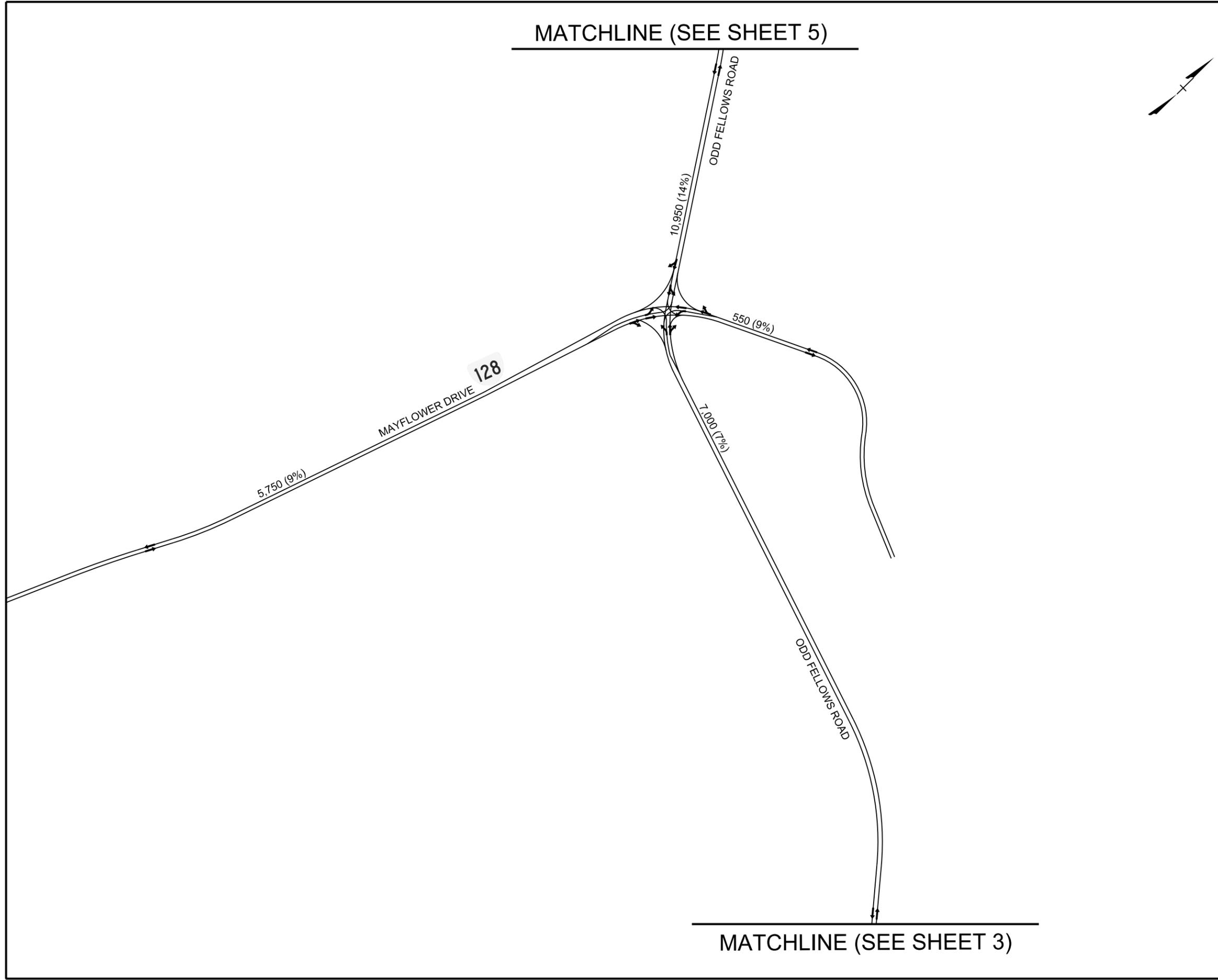


DATE:
DECEMBER 2012

2016 OPENING YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 6 OF 6

LEGEND
 ← Existing Number of Lanes
 ← on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-9



MATCHLINE (SEE SHEET 5)

MATCHLINE (SEE SHEET 3)

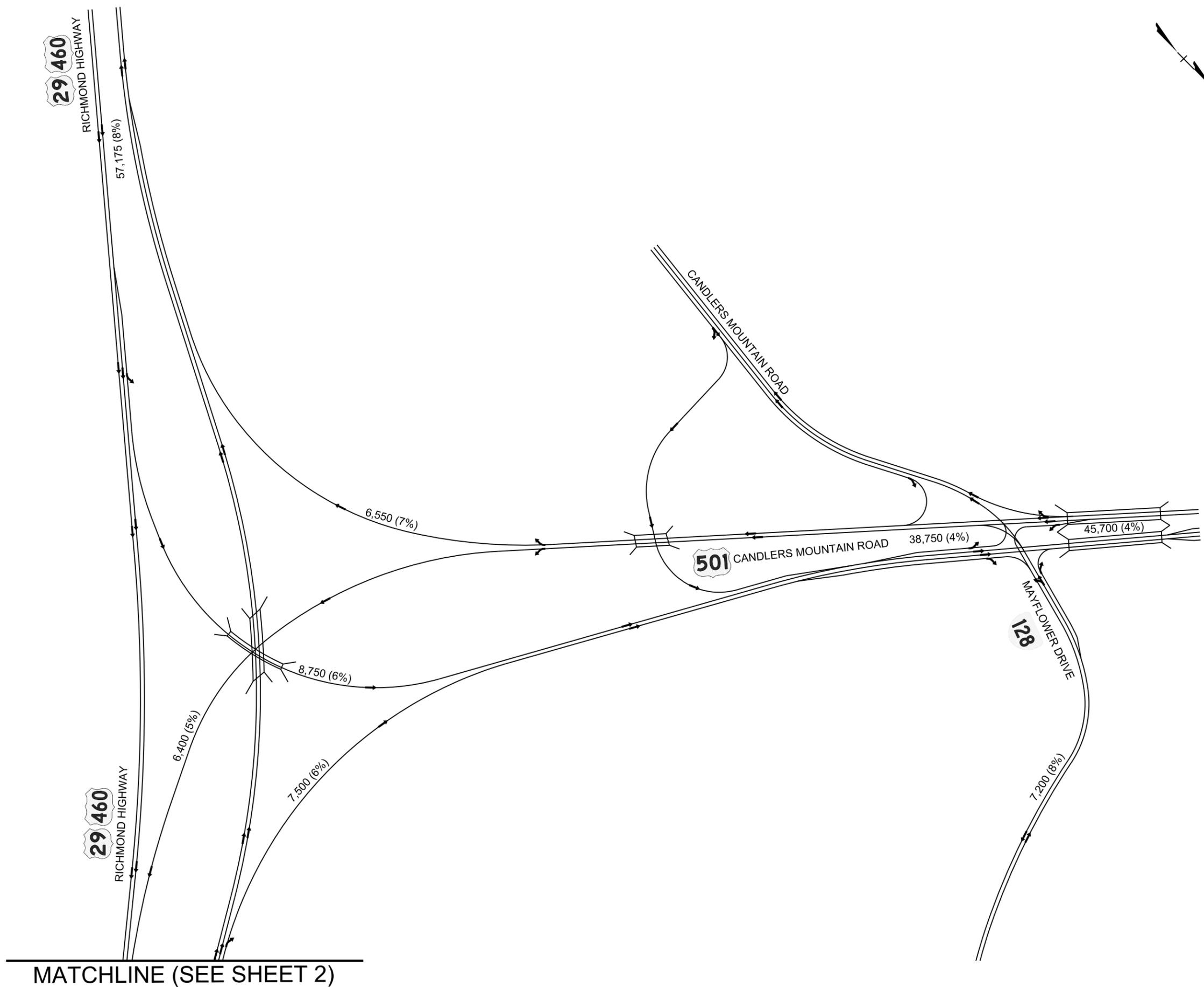
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 1 OF 6

LEGEND	FIGURE
← Existing Number of Lanes	6-10
← on Roadway Segments	
AADT VOLUME (TRUCK %)	



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 2 OF 6

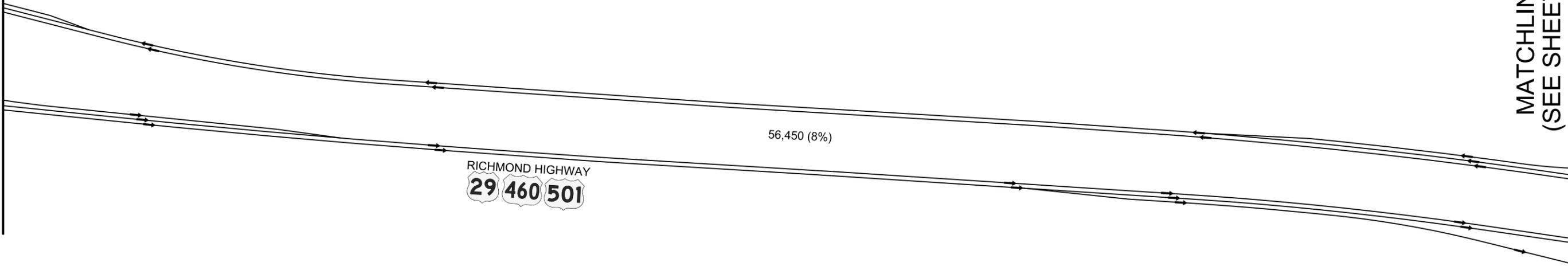
LEGEND
← Existing Number of Lanes
← on Roadway Segments
AADT VOLUME (TRUCK %)

FIGURE
6-10



MATCHLINE (SEE SHEET 1)

MATCHLINE
(SEE SHEET 3)



ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



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DECEMBER 2012

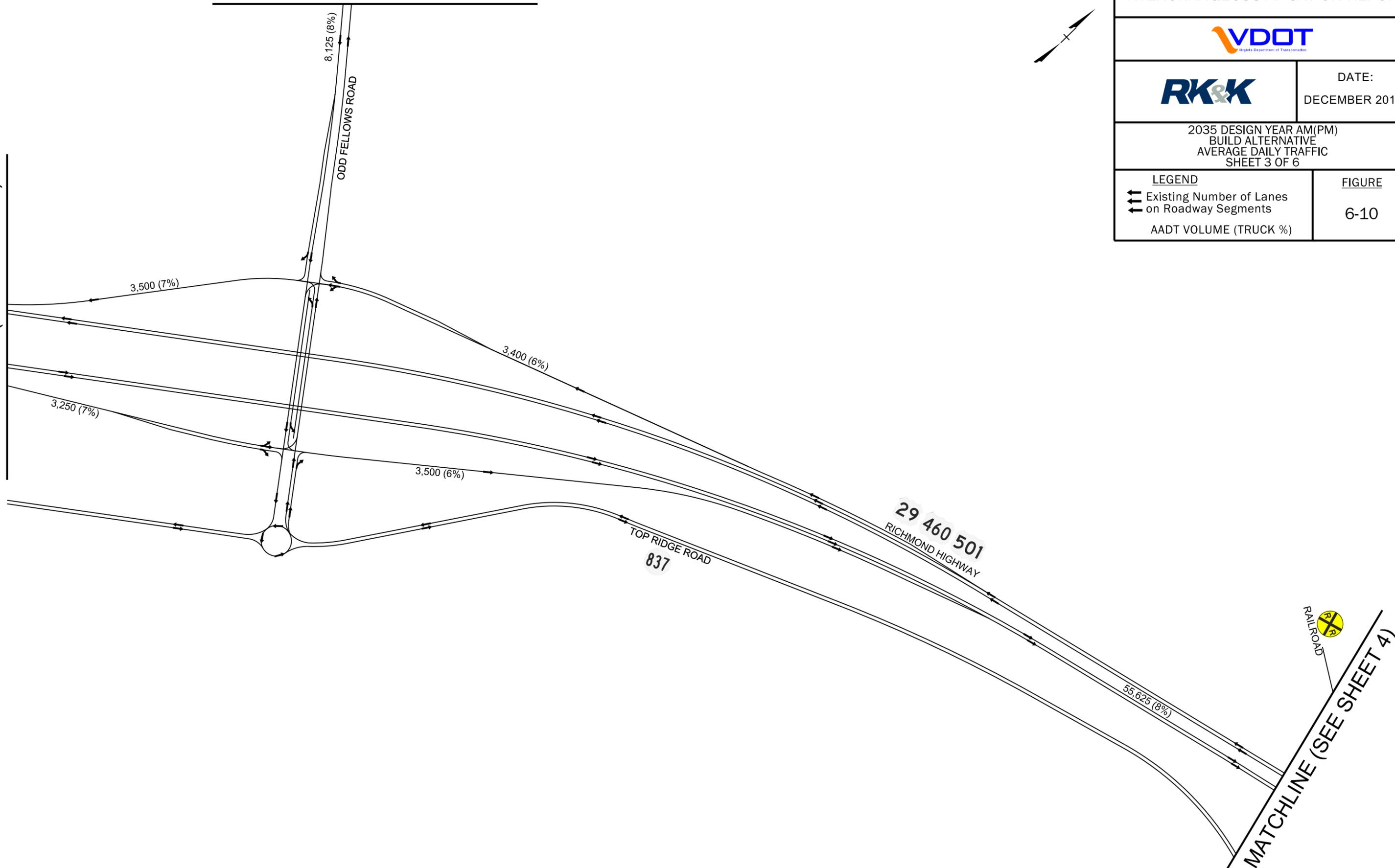
2035 DESIGN YEAR AM(PM)
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 3 OF 6

LEGEND	FIGURE
Existing Number of Lanes on Roadway Segments AADT VOLUME (TRUCK %)	6-10

MATCHLINE (SEE SHEET 6)



MATCHLINE (SEE SHEET 2)



MATCHLINE (SEE SHEET 4)

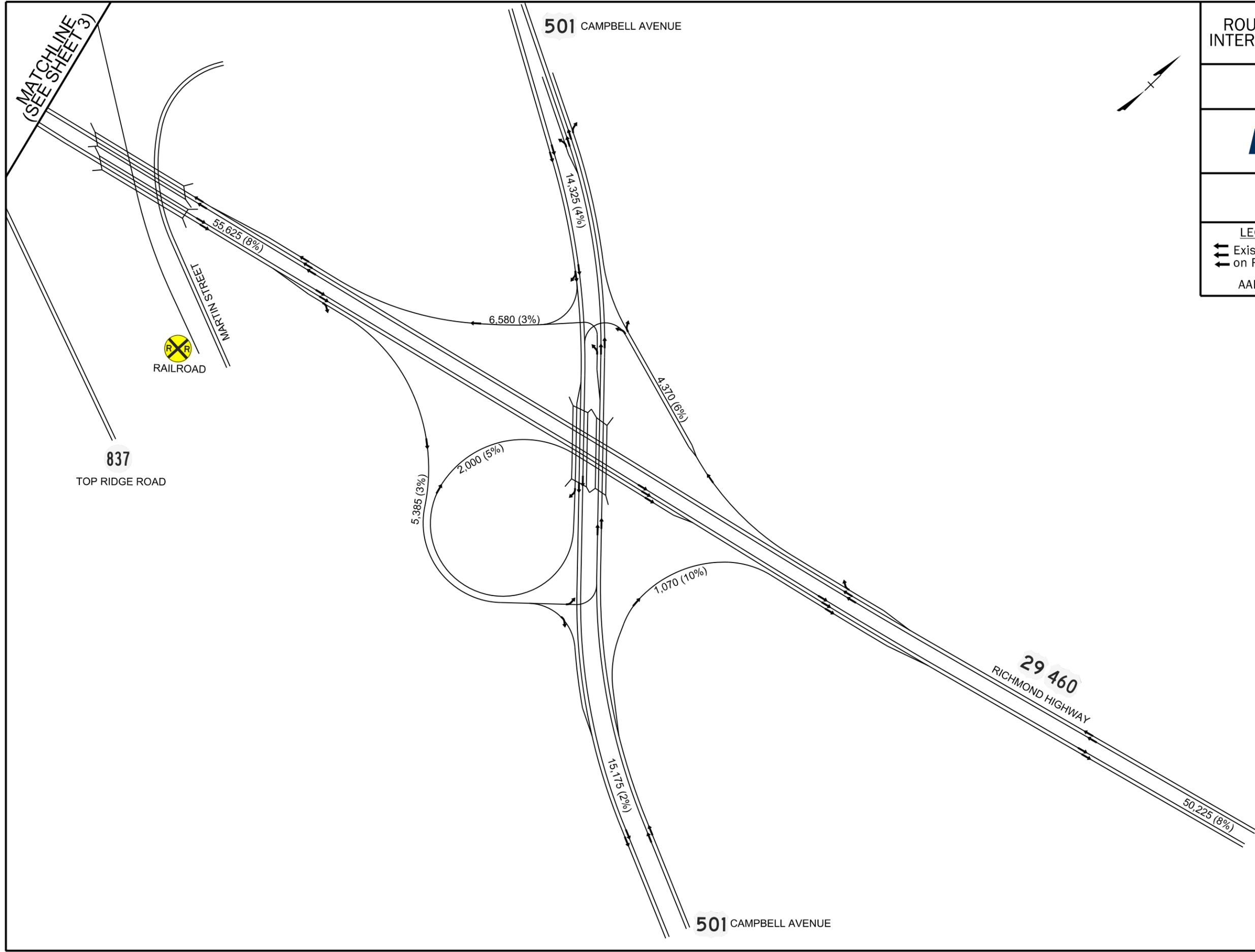
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 4 OF 6

LEGEND	FIGURE
<ul style="list-style-type: none"> ← Existing Number of Lanes ← on Roadway Segments 	6-10
AADT VOLUME (TRUCK %)	



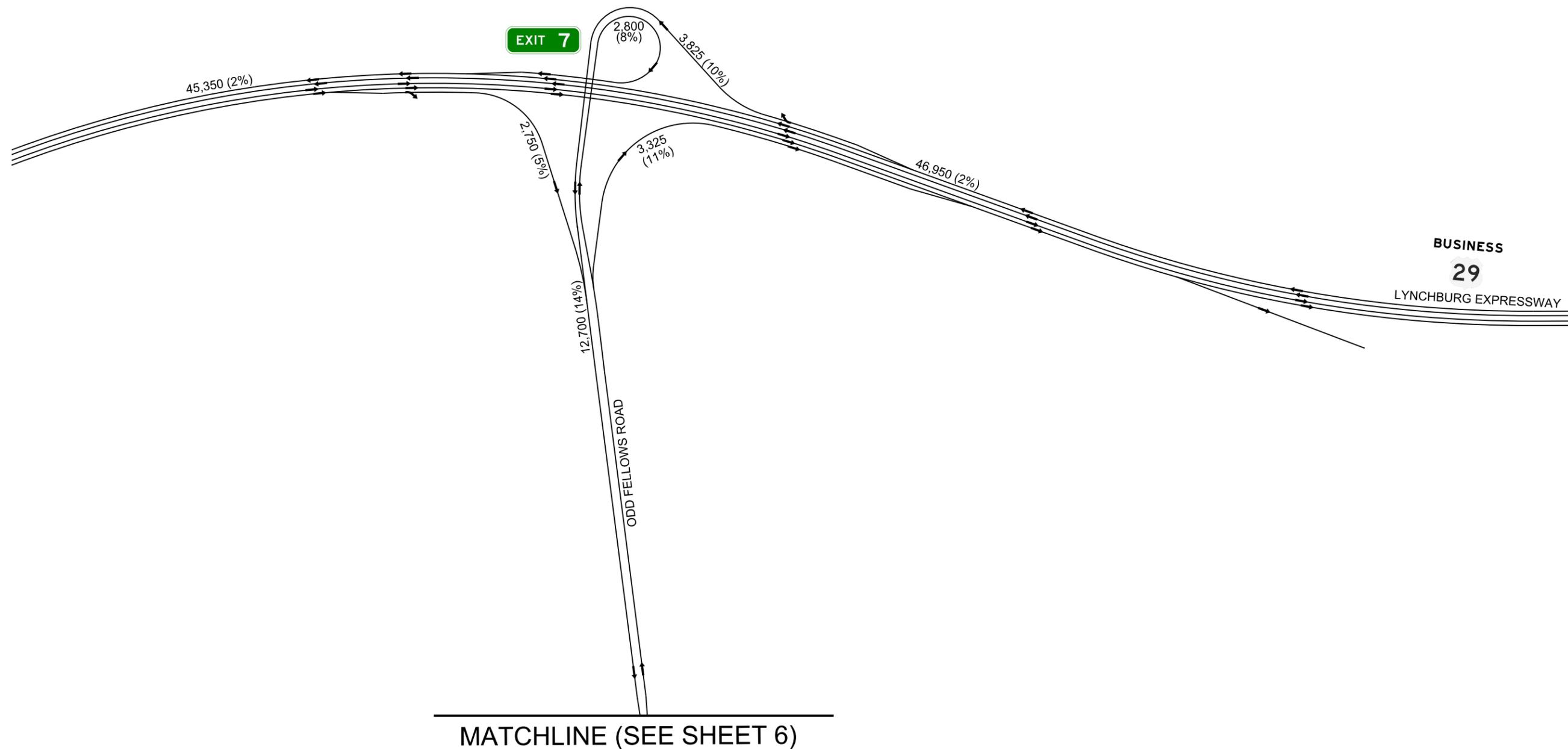
ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 5 OF 6

LEGEND	FIGURE
<ul style="list-style-type: none"> ← Existing Number of Lanes ← on Roadway Segments 	6-10
AADT VOLUME (TRUCK %)	



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

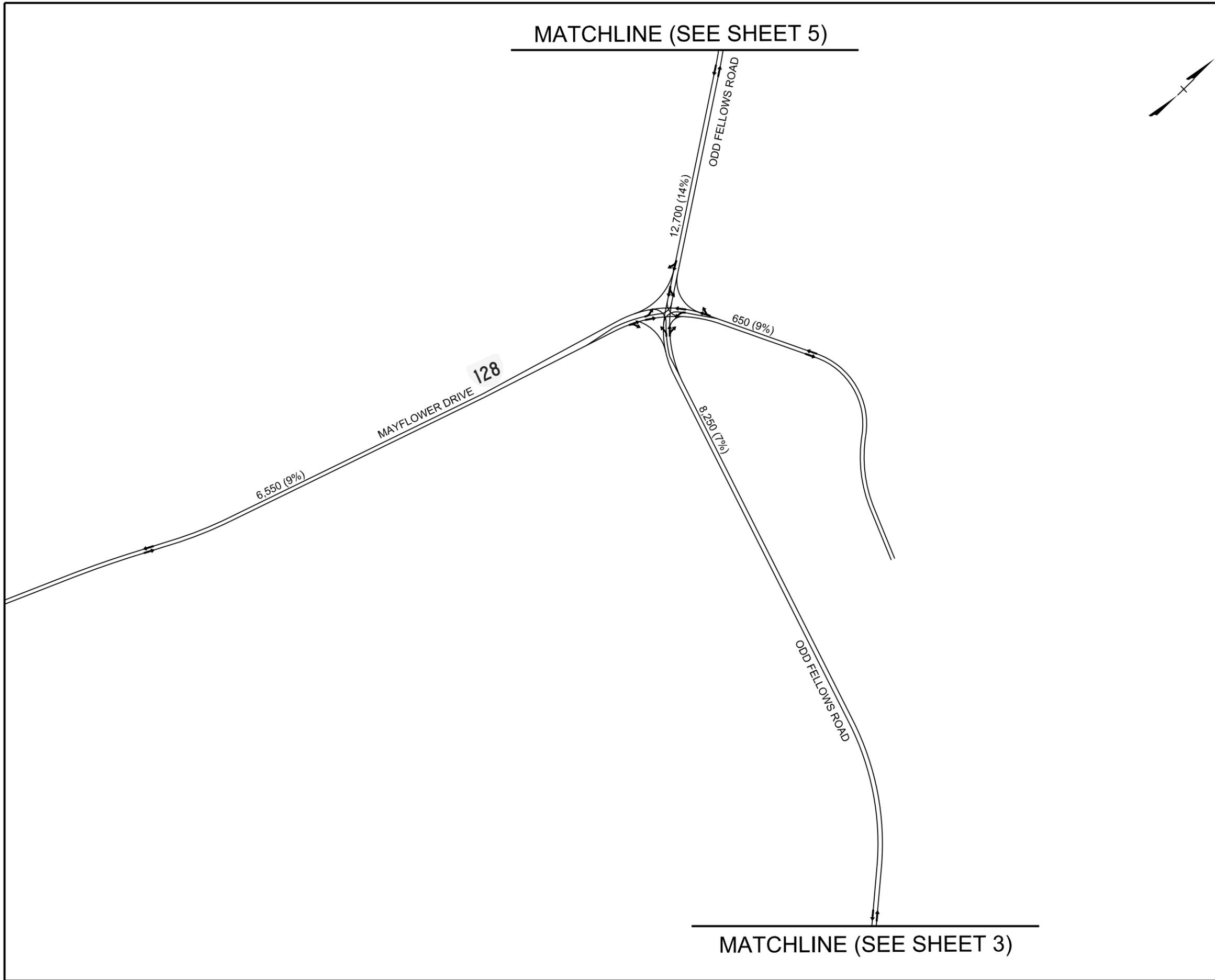


DATE:
DECEMBER 2012

2035 DESIGN YEAR
BUILD ALTERNATIVE
AVERAGE DAILY TRAFFIC
SHEET 6 OF 6

LEGEND
 Existing Number of Lanes
 on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-10



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

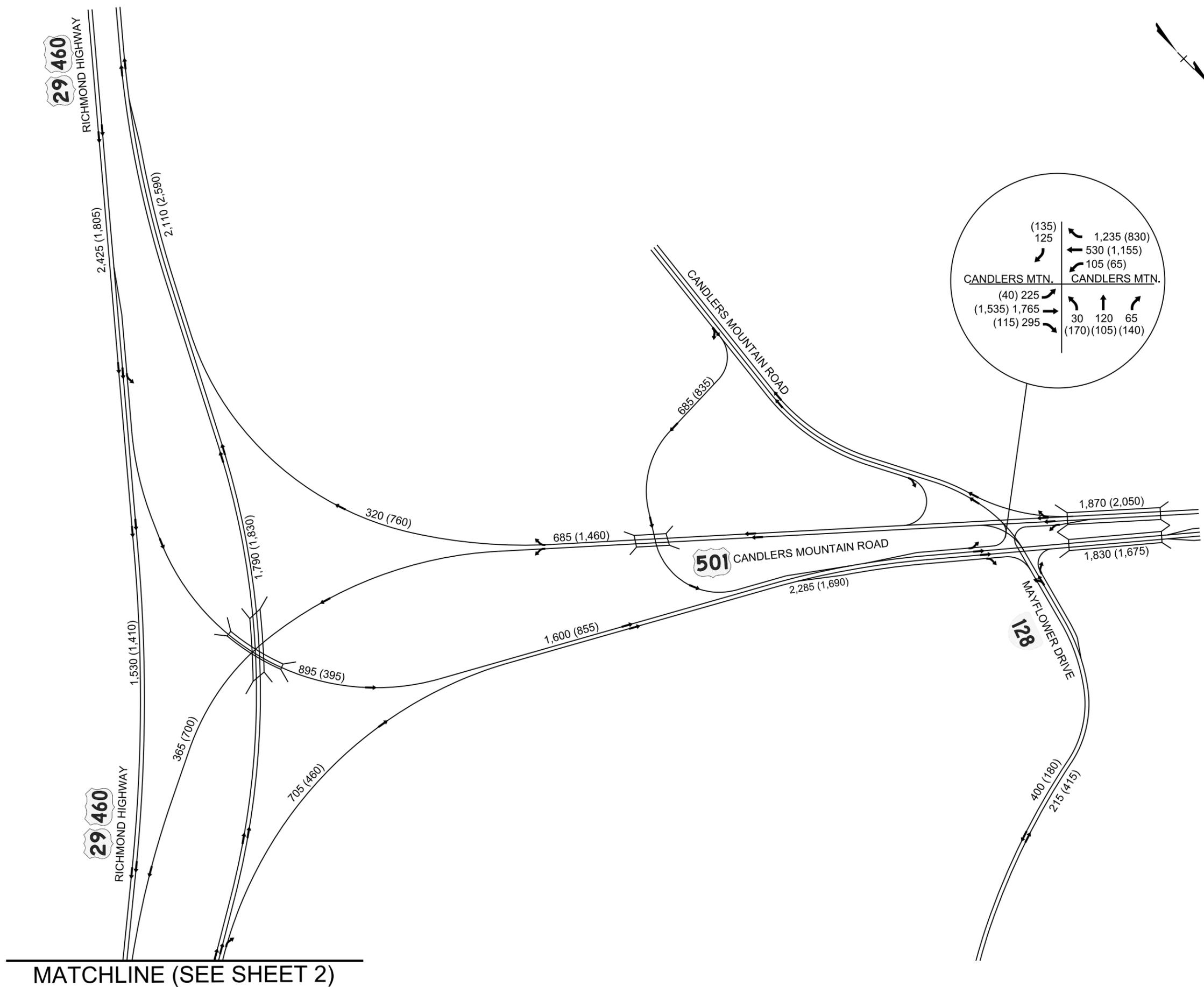


DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 1 OF 6

LEGEND
 Existing Number of Lanes
 on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-11



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 2 OF 6

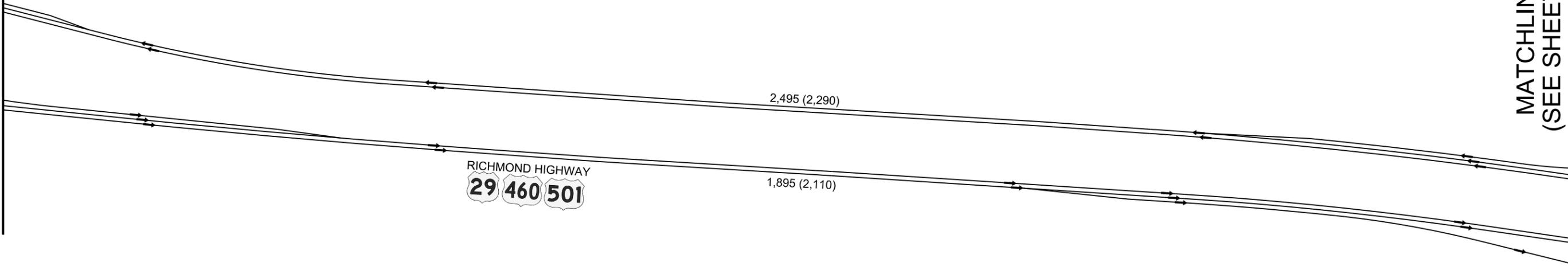
LEGEND
 ← Existing Number of Lanes
 ← on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-11



MATCHLINE (SEE SHEET 1)

MATCHLINE
(SEE SHEET 3)



ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

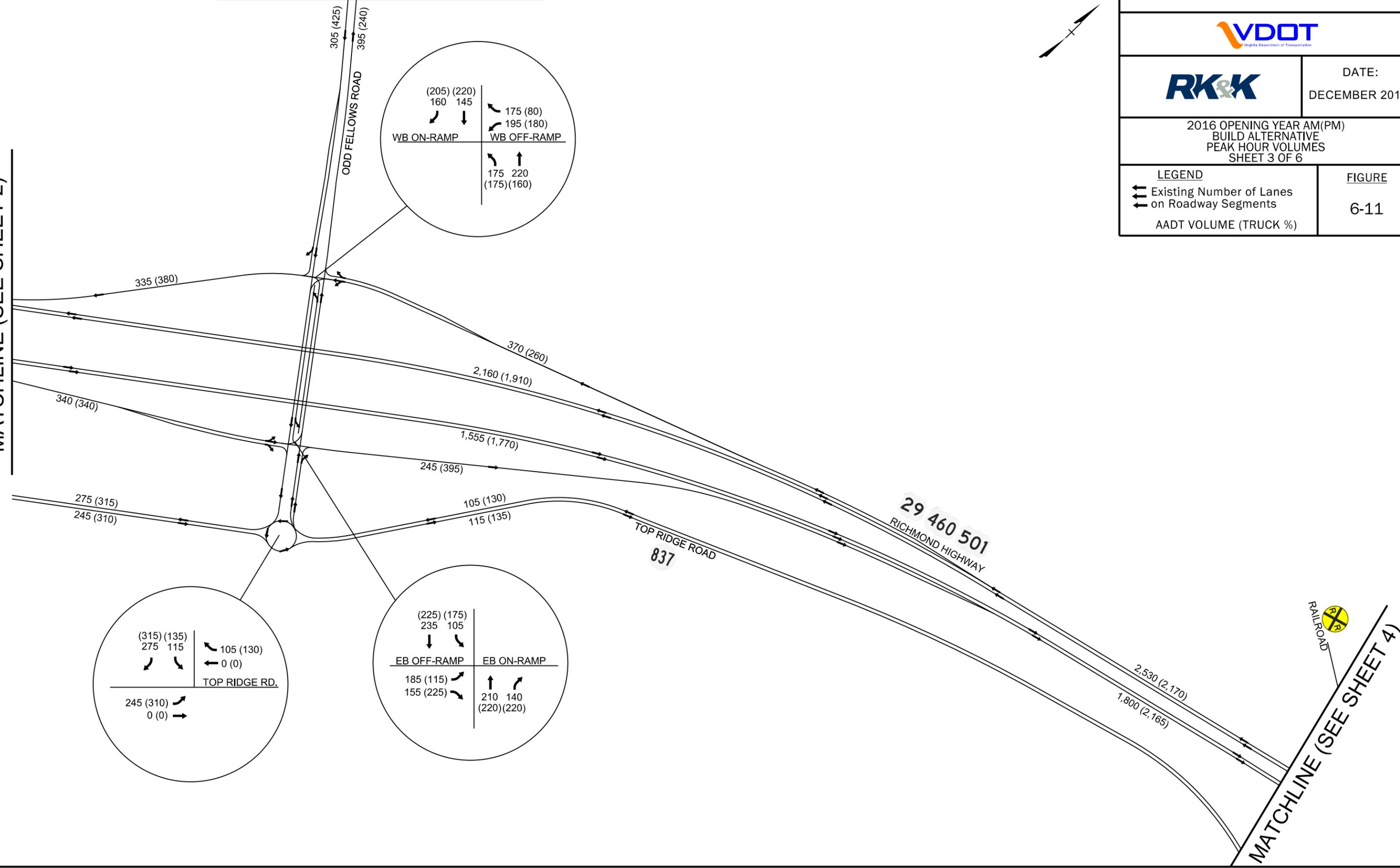
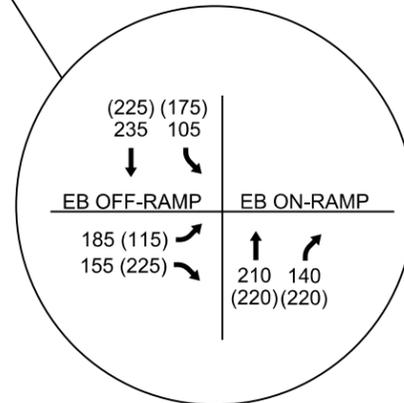
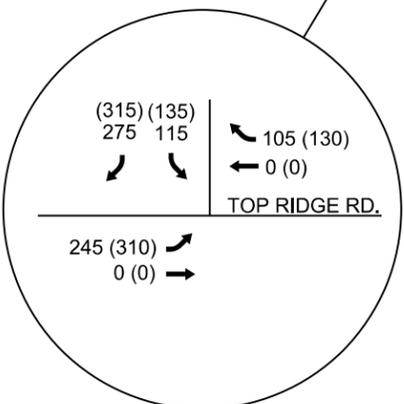
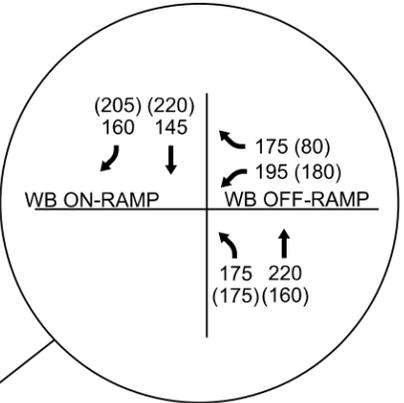
2016 OPENING YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 3 OF 6

LEGEND
 Existing Number of Lanes
 on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-11

MATCHLINE (SEE SHEET 6)

MATCHLINE (SEE SHEET 2)



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

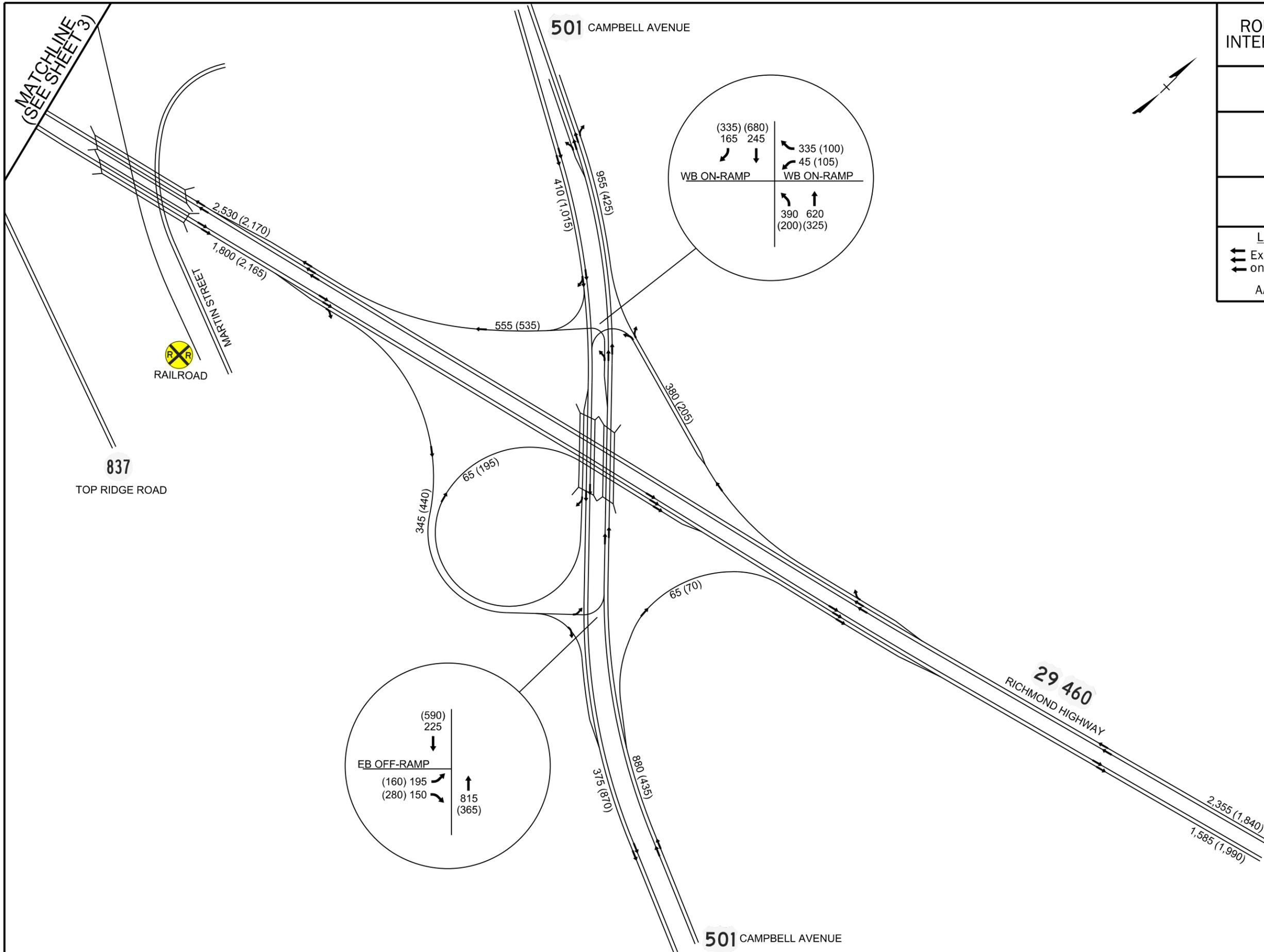


DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 4 OF 6

LEGEND
 Existing Number of Lanes
 on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-11



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

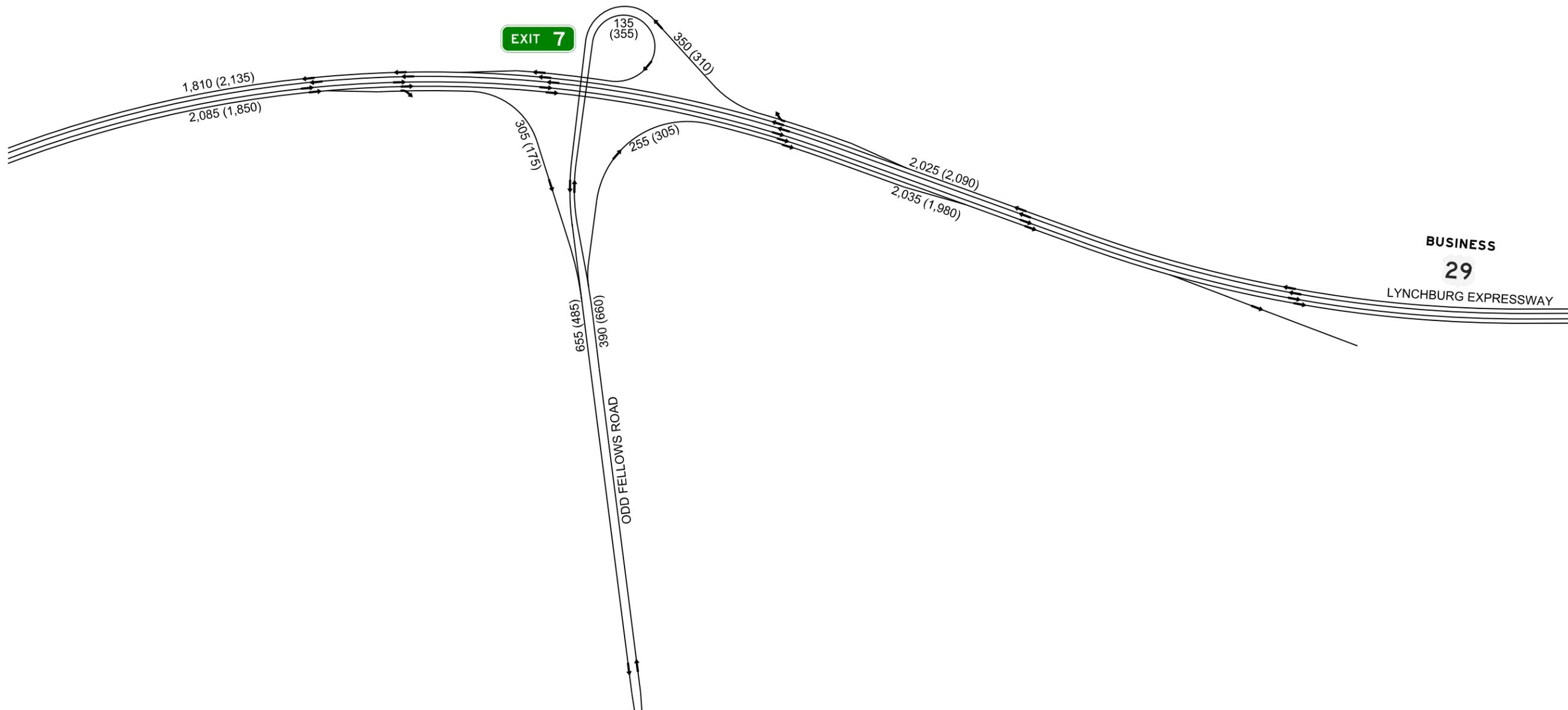
2016 OPENING YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 5 OF 6

LEGEND

- ← Existing Number of Lanes
- ← on Roadway Segments
- AADT VOLUME (TRUCK %)

FIGURE

6-11



MATCHLINE (SEE SHEET 6)

ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT

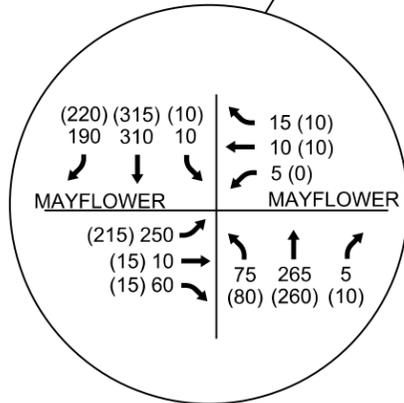
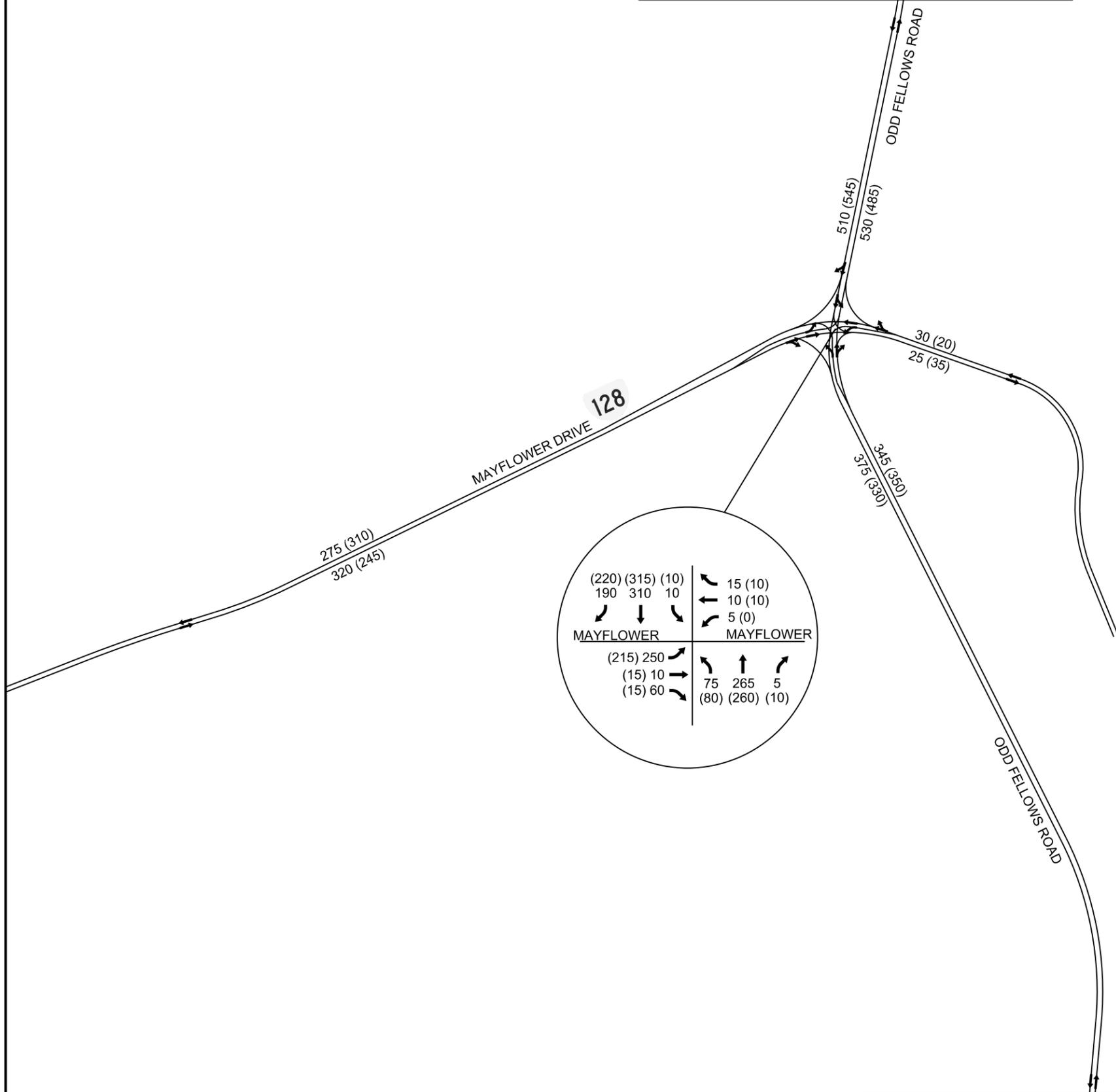


DATE:
DECEMBER 2012

2016 OPENING YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 6 OF 6

LEGEND	FIGURE
Existing Number of Lanes on Roadway Segments AADT VOLUME (TRUCK %)	6-11

MATCHLINE (SEE SHEET 5)



MATCHLINE (SEE SHEET 3)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT

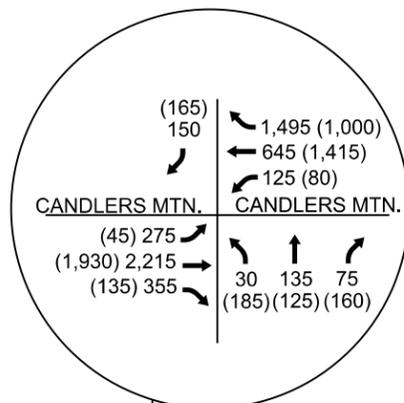
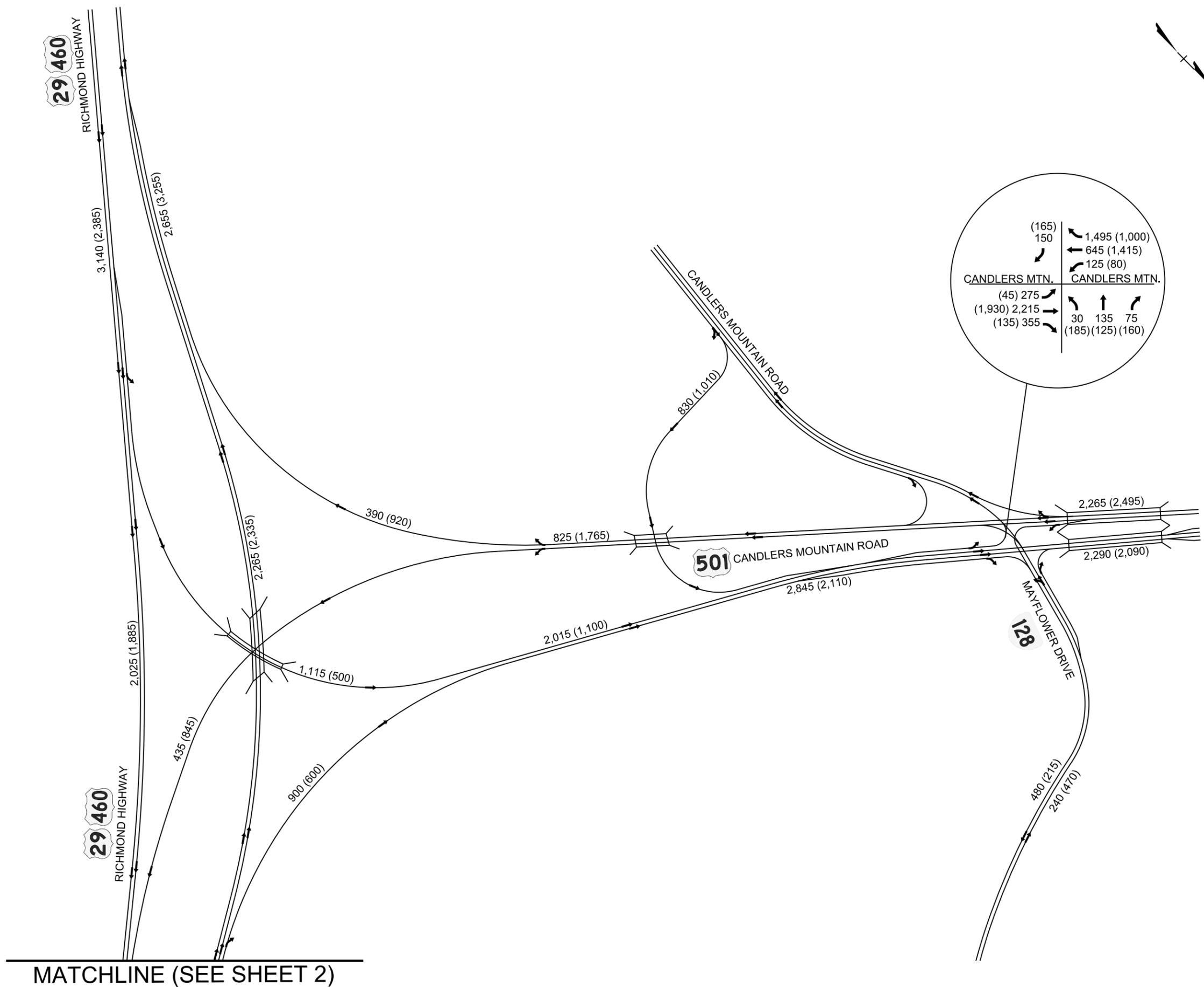


DATE:
DECEMBER 2012

2035 DESIGN YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 1 OF 6

LEGEND
 Existing Number of Lanes
 on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-12



MATCHLINE (SEE SHEET 2)

ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

2035 DESIGN YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 2 OF 6

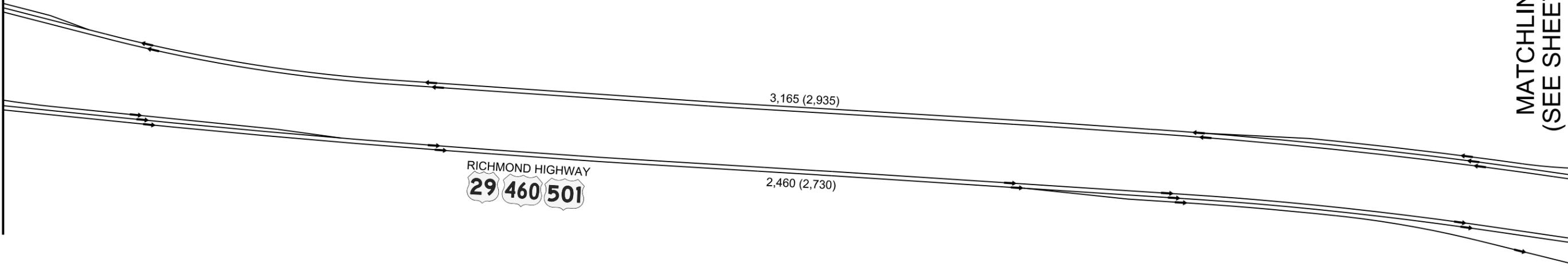
LEGEND
 ← Existing Number of Lanes
 ← on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
 6-12



MATCHLINE (SEE SHEET 1)

MATCHLINE
(SEE SHEET 3)



RICHMOND HIGHWAY
 29 460 501

3,165 (2,935)

2,460 (2,730)

ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

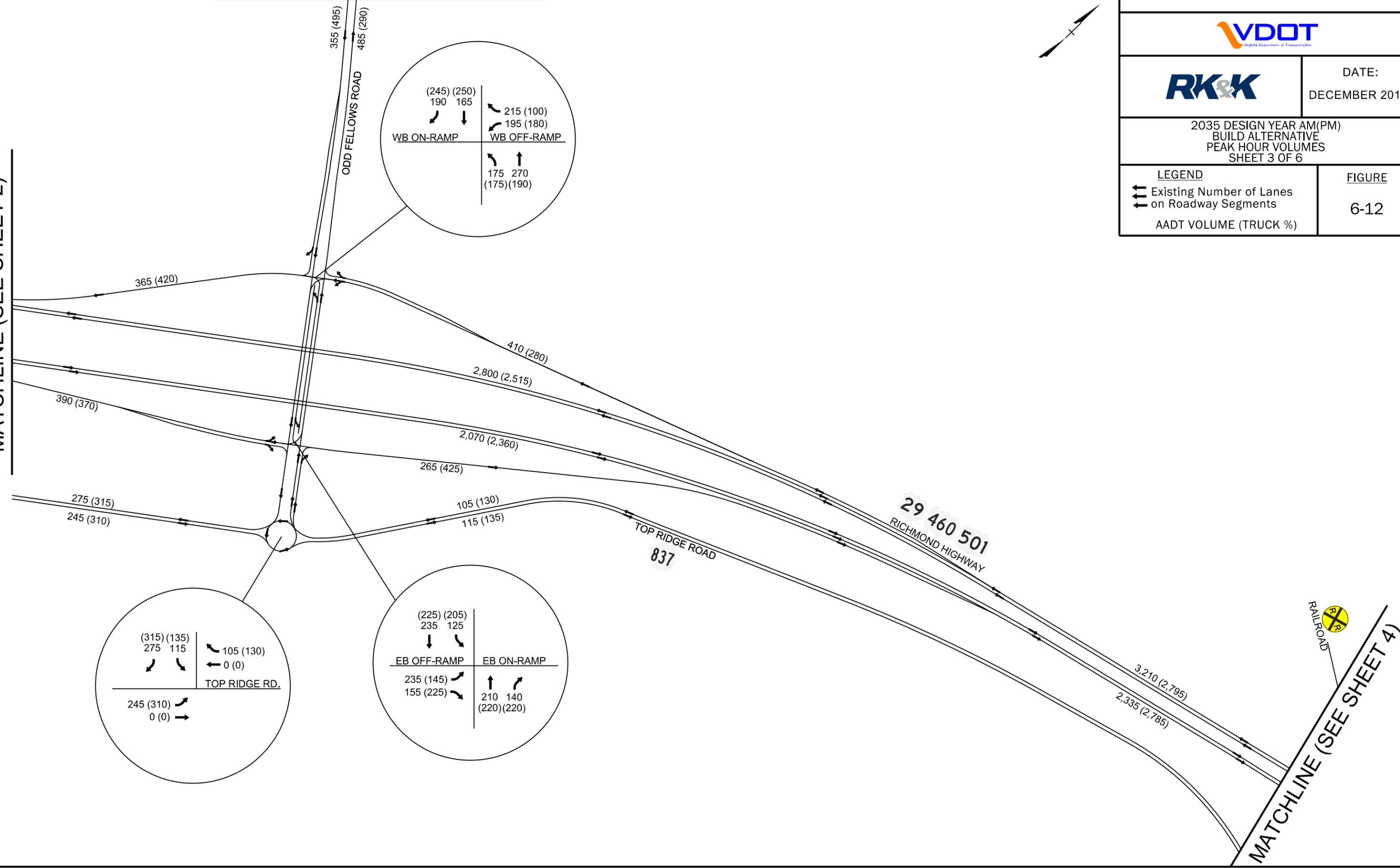
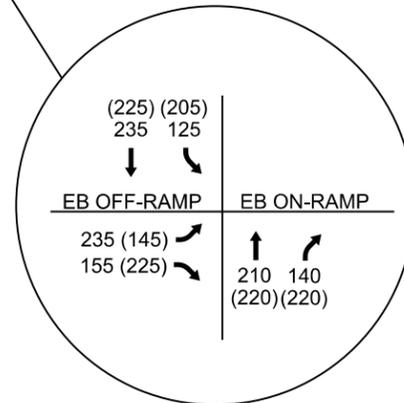
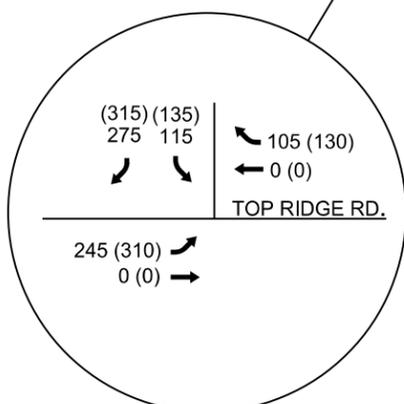
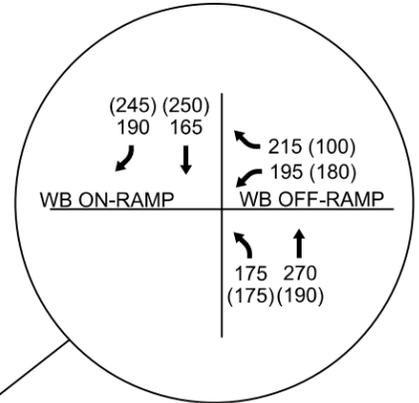
2035 DESIGN YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 3 OF 6

LEGEND
 Existing Number of Lanes
 on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-12

MATCHLINE (SEE SHEET 6)

MATCHLINE (SEE SHEET 2)



MATCHLINE (SEE SHEET 4)



ROUTE 460 / ODD FELLOWS ROAD
INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

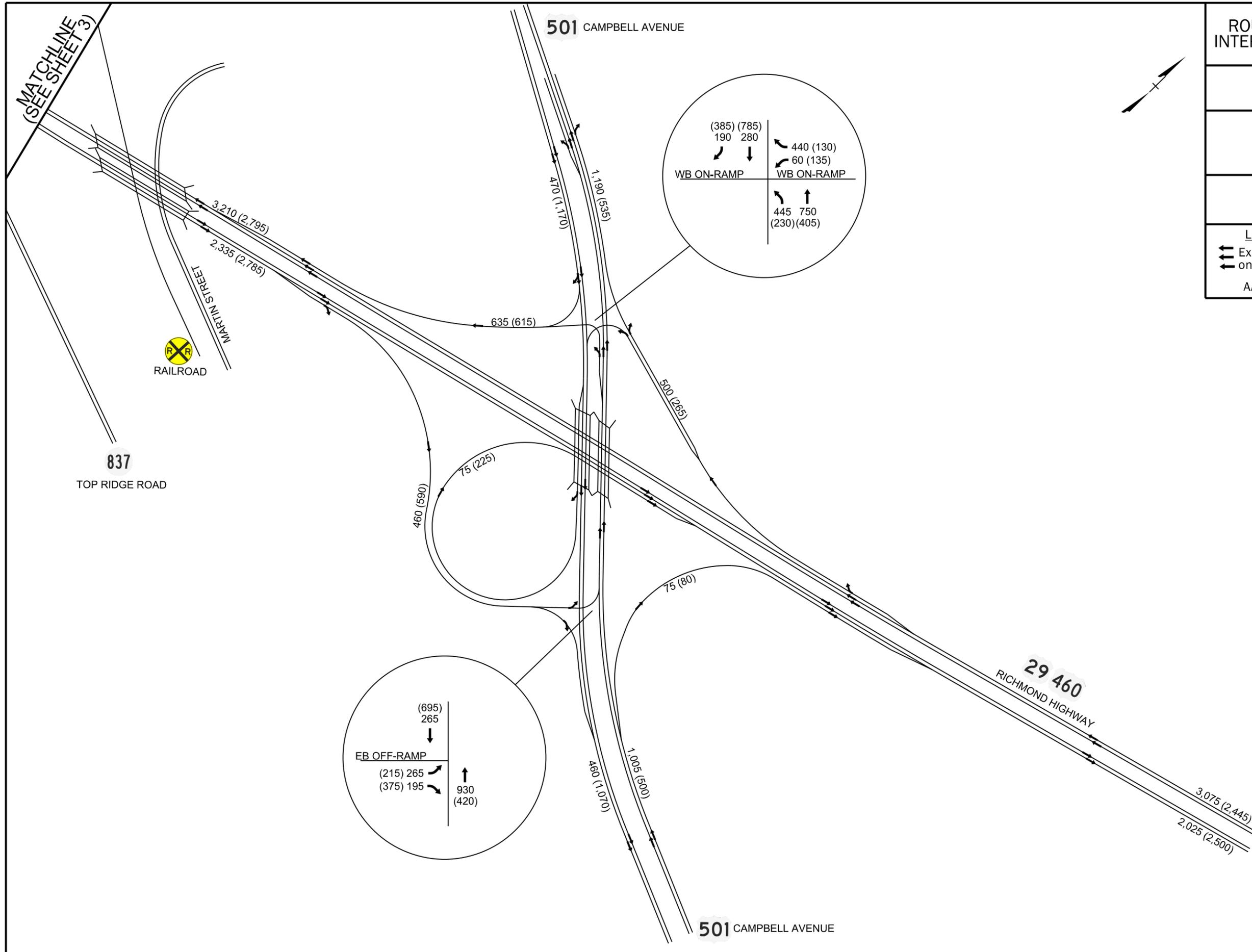
2035 DESIGN YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 4 OF 6

LEGEND

- ← Existing Number of Lanes
- on Roadway Segments
- AADT VOLUME (TRUCK %)

FIGURE

6-12



ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT



DATE:
DECEMBER 2012

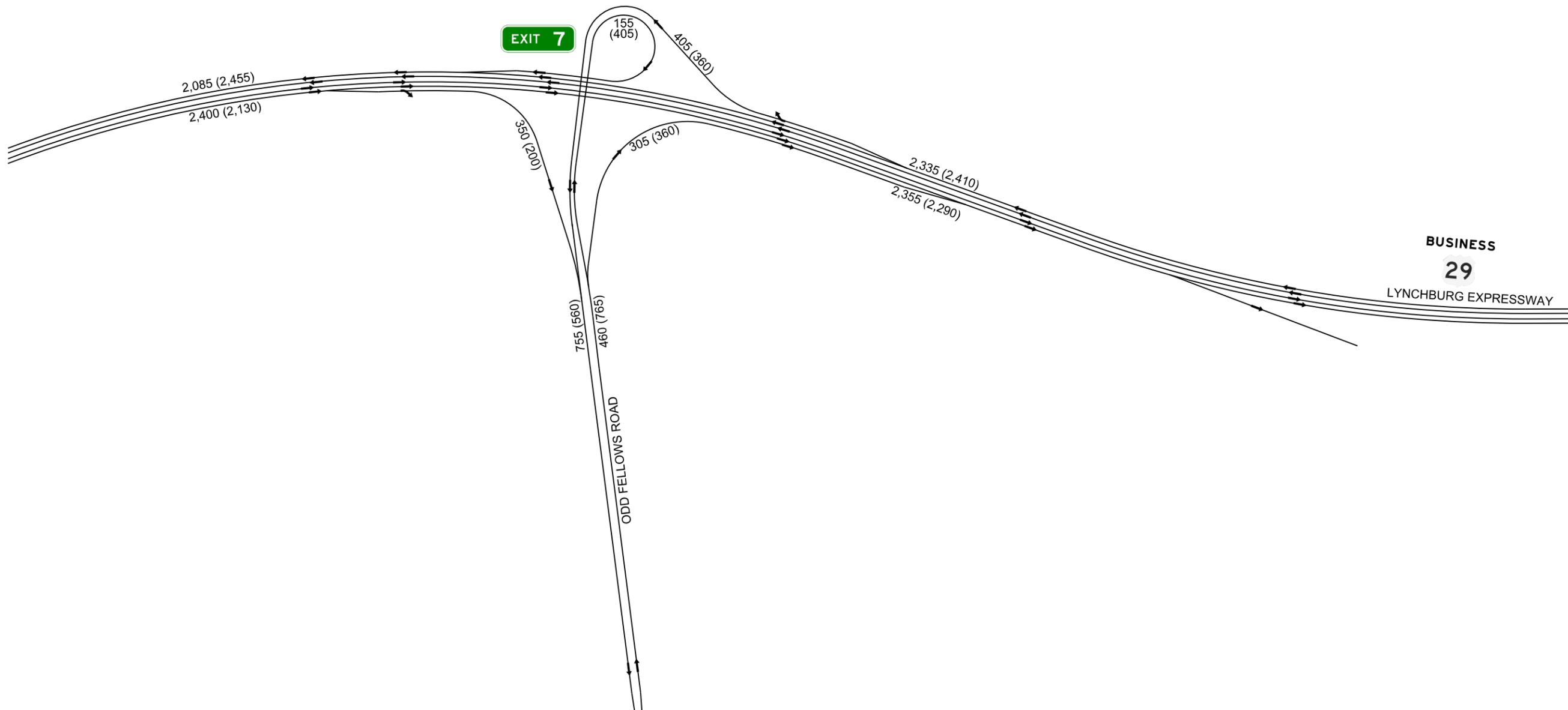
2035 DESIGN YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 5 OF 6

LEGEND

- ← Existing Number of Lanes
- ← on Roadway Segments
- AADT VOLUME (TRUCK %)

FIGURE

6-12



MATCHLINE (SEE SHEET 6)

ROUTE 460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT

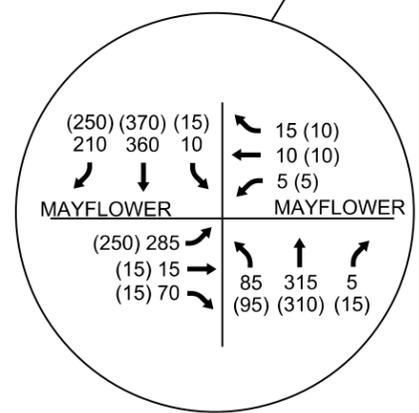
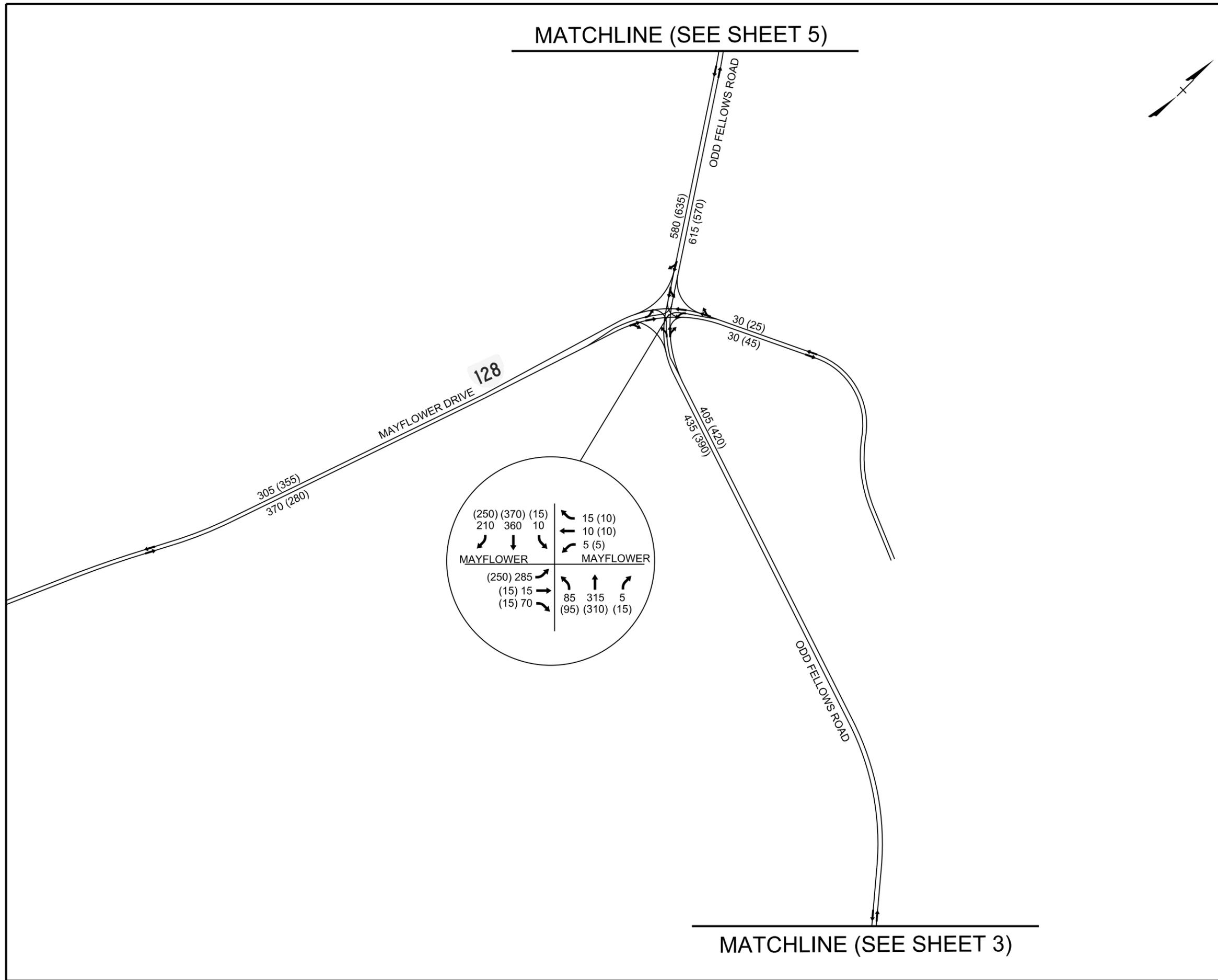


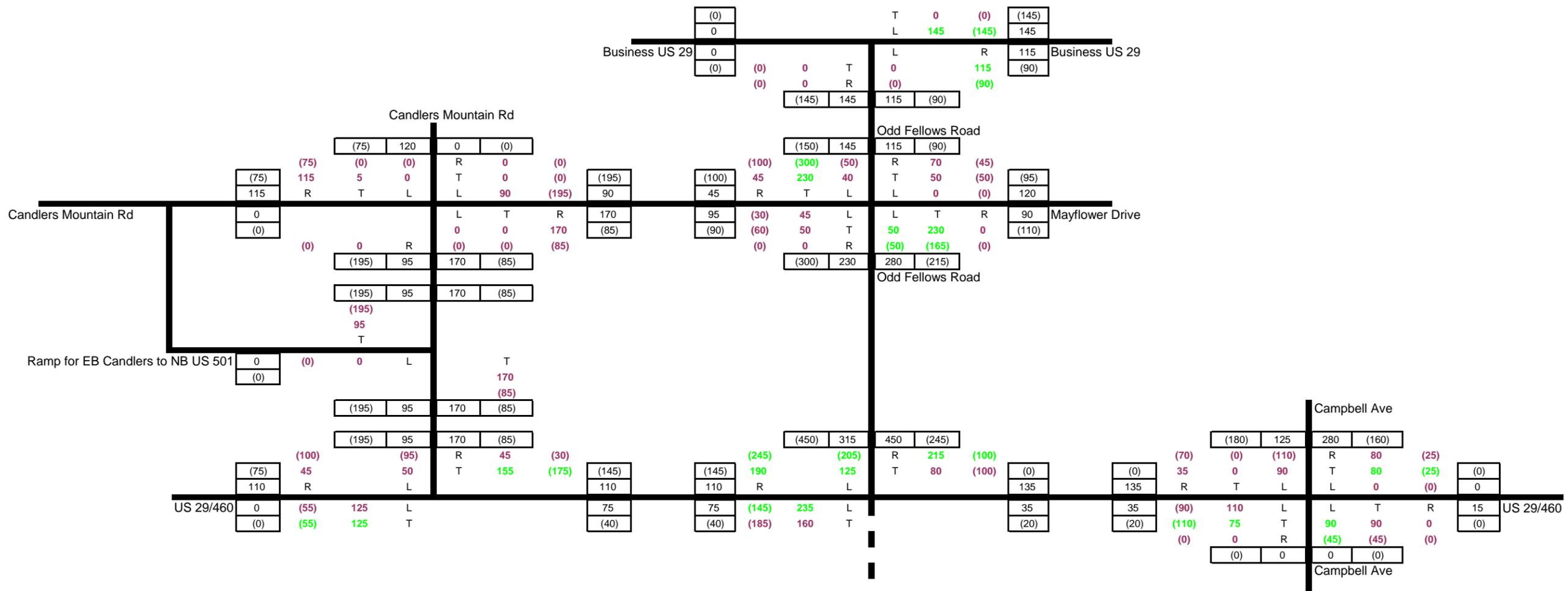
DATE:
DECEMBER 2012

2035 DESIGN YEAR AM(PM)
BUILD ALTERNATIVE
PEAK HOUR VOLUMES
SHEET 6 OF 6

LEGEND
 ← Existing Number of Lanes
 → on Roadway Segments
 AADT VOLUME (TRUCK %)

FIGURE
6-12





Reduction in Volume
 Increase in Volume

Figure 6-13
 2035 AM(PM) Design Year Peak Hour Volumes
 Change from No Build to Build Scenario #1 Volumes
 December 2012 Project: 0460-118-217, P101; UPC 100023



7. TRAFFIC ANALYSIS

7.1. Traffic Operations – Design Level of Service (LOS) Standards

The results of the traffic analyses presented in this Chapter were evaluated based on guidance from an FHWA Memorandum titled “Design Criteria – Level of Service” dated March 19, 2001. This memorandum summarizes the Level of Service requirements for projects on the National Highway System (NHS), which includes Interstate highways. Per this memorandum, on urban NHS routes, including Interstates, the Level of Service requirement for mainline lanes is Level of Service (LOS) C. For auxiliary facilities, including ramps and intersections, the Level of Service requirement is also LOS C. Throughout this IJR, “acceptable” operations for the Route 460 mainline lanes are defined as LOS C or better and “unacceptable” operations are defined as LOS D or worse. For auxiliary facilities, “acceptable” operations are also defined as LOS C or better.

7.2. Traffic Operations – Existing

Operational analysis for this IJR was conducted using the analysis tools *HCS 2010* and *Synchro Version 8 (Build 801, Revision 563)* as well as the microsimulation tools *VISSIM (Version 5.30)* and *SimTraffic*, the companion microsimulation tool for *Synchro*. Details on the calibration of the *VISSIM* model for this study can be found in Chapter 3.

7.2.1. Mainline Operations

Freeway Segments: The existing 2011 operations along the freeway corridors of Route 460 and Business Route 29 were evaluated using both *HCS 2010* and the calibrated *VISSIM* model. The analysis results for both techniques, including the average of ten (10) *VISSIM* runs, for the freeway segments within the Study Area are summarized in Table 7-1.

Table 7-1. 2011 Operational Performance of the Freeway Segments

Route	Location	Direction	HCS 2010 Results				VISSIM Results			
			Density (pc/mi/lane)		LOS		Density (veh/mi/lane)		LOS Range	
			AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Route 460	West of Candler Mountain Road	EB	14.2	10.4	B	A	14.0	10.3	B	B
		WB	10.1	17.2	A	B	9.3	15.2	A	B
Route 460	Candler Mountain Road to Campbell Avenue	EB	9.8	13.0	A	B	9.8	12.7	A	B
		WB	13.2	14.3	B	B	13.0	13.9	B	B
Route 460	East of Campbell Avenue	EB	8.2	12.6	A	B	8.2	12.3	A	B
		WB	12.6	11.7	B	B	12.0	11.0	B	B
Business Route 29	North of Odd Fellows Road	NB	17.3	14.3	B	B	15.9	13.9	B	B
		SB	17.4	14.2	B	B	15.0	14.6	B	B
Business Route 29	South of Odd Fellows Road	NB	18.6	13.8	C	B	15.7	14.0	B	B
		SB	16.5	15.5	B	B	15.2	15.0	B	B

The HCS analysis results in Table 7-1 indicate densities between eight (8) and seventeen (17) passenger cars per mile per lane along the Route 460 corridor. Overall, these densities indicate acceptable operations (LOS C or better) during the AM and PM peak periods along both freeway corridors. The HCS analysis shows the freeway segments currently operate in the LOS A/B range along Route 460, and LOS B/C range along Business Route 29. The VISSIM analysis results indicate very similar or slightly better operations, with the freeway segments currently operating in the LOS A/B range. For most segments, the VISSIM results are the same or one LOS grade better than those predicted by the HCS analysis.

Ramp Junctions: Capacity analyses were also conducted using both HCS 2010 for the ramp junctions (merges / diverges) along Route 460 at Candler Mountain Road and Campbell Avenue and along Business Route 29 at Odd Fellows Road. The results of the ramp junction analysis for Route 460 are summarized in Table 7-2, and the results for Business Route 29 are summarized in Table 7-3.

Table 7-2. 2011 Operational Performance - Ramp Junctions (Route 460)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Candlers Mountain Road Eastbound Off-Ramp	17.3	12.7	B	B	8.8	8.0	A	A
Candlers Mountain Road Eastbound On-Ramp	11.9	15.2	B	B	9.5	12.2	A	B
Candlers Mountain Road Westbound Off-Ramp	17.9	19.2	B	B	9.0	11.4	A	B
Candlers Mountain Road Westbound On-Ramp	13.1	20.5	B	C	9.7	15.5	A	B
Campbell Avenue Eastbound Off-Ramp	13.4	17.2	B	B	8.2	11.0	A	B
Campbell Avenue Southbound to Eastbound On-Ramp	11.8	16.7	B	B	7.7	11.9	A	B
Campbell Avenue Northbound to Eastbound On-Ramp	11.7	16.4	B	B	8.1	12.4	A	B
Campbell Avenue Westbound Off-Ramp	15.8	14.7	B	B	10.0	10.0	B	B
Campbell Avenue Westbound On-Ramp	17.4	18.3	B	B	11.8	12.7	B	B

Table 7-3. 2011 Operational Performance - Ramp Junctions (Business Route 29)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Odd Fellows Road Northbound Off-Ramp	22.2	16.8	C	B	15.7	14.0	B	B
Odd Fellows Road Northbound On-Ramp	20.8	16.5	C	B	15.6	13.8	B	B
Odd Fellows Road Southbound Off-Ramp	19.9	16.3	B	B	13.5	13.4	B	B
Odd Fellows Road Southbound On-Ramp	20.6	20.5	C	C	16.0	15.7	B	B

The HCS analysis results indicate densities ranging from approximately twelve (12) to twenty-one (21) passenger cars per mile per lane within the various ramp merge and diverge areas along Route 460. Along Business Route 29, the analysis results indicate densities ranging from sixteen (16) and twenty-two (22) passenger cars per mile per lane. These densities indicate uncongested operations (LOS B / LOS C) during the AM and PM peak periods along both freeways.

One additional ramp junction, along northbound Candlers Mountain Road, approaching Mayflower Drive was also analyzed. The results are summarized in Table 7-4.

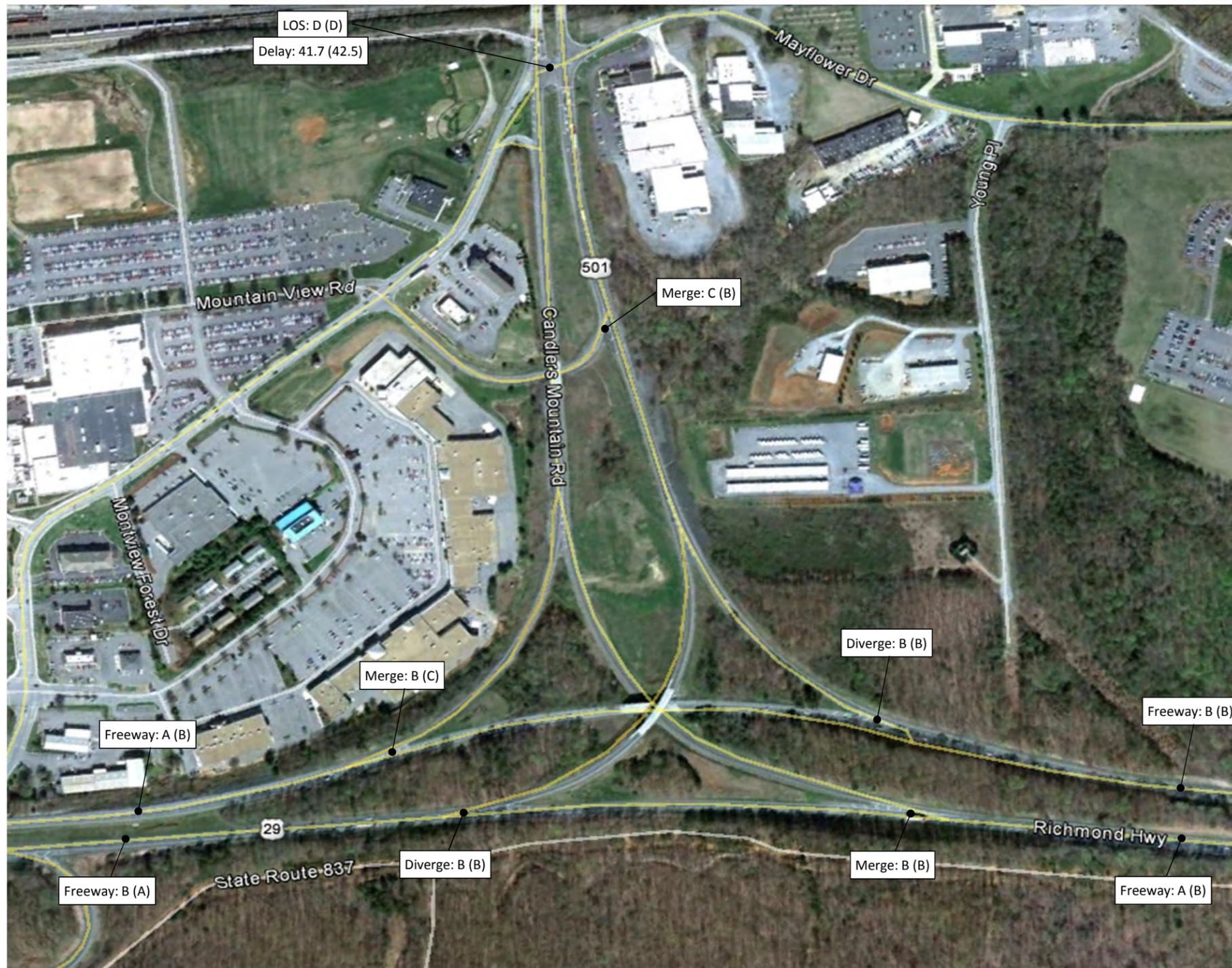
Table 7-4. 2011 Operational Performance - Ramp Junctions (Candlers Mountain Road)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Candlers Mountain Shopping Center	21.7	17.4	C	B	23.1	15.5	C	B

Figure 7-1 summarizes the existing 2011 freeway segment and ramp junction traffic operations.

7.2.2. Intersection Analysis

Synchro and *SimTraffic* were utilized to assess the operations of four (4) key intersections along Candlers Mountain Road, Odd Fellows Road, and Campbell Avenue. Levels of Service and delay are reported from the HCM Signals and Unsignalized Reports within *Synchro*. The maximum queues are reported from an average of five (5) simulation runs in *SimTraffic*. Table 7-5 summarizes the average AM and PM peak hour delay and maximum queues for each lane group at all Study Area intersections.







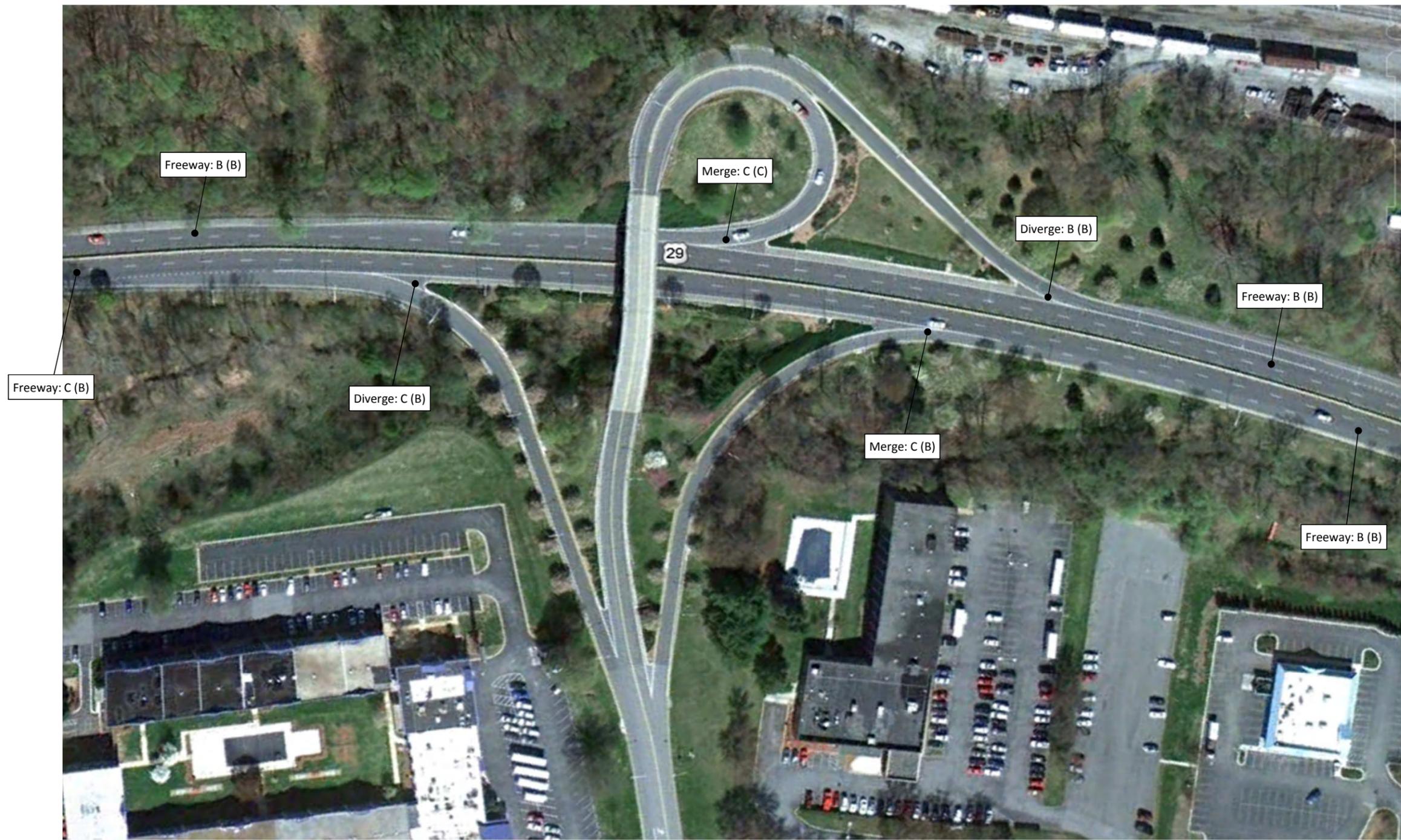


Table 7-5. Existing (2011) Intersection Operations

Intersection	Movement	AM			PM		
		Delay (sec/veh)	Maximum Queue (ft)	LOS	Delay (sec/veh)	Maximum Queue (ft)	LOS
Candlers Mountain Road at Mayflower Drive	NB Left	80.7	285	F	28.4	270	C
	NB Thru	17.0	595	B	18.6	420	B
	NB Right	11.1	195	B	10.6	80	B
	SB Left	22.0	250	C	15.9	260	B
	SB Thru	63.4	635*	E	30.0	635*	C
	SB Right						
	WB Left	68.5	620	E	195.0	940	F
	WB Thru						
	WB Right	39.3	280	D	42.5	280	D
ALL	41.7	-	D	42.5	-	D	
Odd Fellows Road at Mayflower Drive	EB Left	16.9	150	B	16.9	150	B
	EB Thru	14.5	515	B	14.2	160	B
	EB Right						
	WB Left	30.3	55	C	29.8	15	C
	WB Thru	33.0	155	C	33.0	125	C
	WB Right						
	NB Left	39.1	100	D	32.0	65	C
	NB Thru	39.2	135	D	33.7	120	C
	NB Right						
	SB Left	33.4	415	C	33.7	220	C
	SB Thru						
SB Right							
ALL	27.6	-	C	26.9	-	C	
Campbell Avenue at Route 460 Eastbound Off-Ramp	EB Left	32.8	440	D	49.1	270	E
	EB Right						
	NB Thru	Free-Flow			Free-Flow		
	SB Thru	Free-Flow			Free-Flow		
	ALL	-	-	-	-	-	-
Campbell Avenue at Route 460 Westbound Ramp Terminals	WB Left	40.0	105	D	66.8	195	E
	WB Right	58.5		E	54.0	-	D
	NB Left	6.9	125	A	9.7	95	A
	NB Thru	6.1	95	A	3.3	85	A
	SB Thru	13.4	185	B	12.0	390	B
	SB Right						
ALL	20.1	-	C	15.9	-	B	

*Queue exceeds available storage to upstream signalized intersection at Murray Place.

The results in Table 7-5 indicate that two of these four (4) intersections operate within acceptable levels (LOS C or better) during the AM peak hour; however, the Candlers Mountain Road / Mayflower Drive and the stop-controlled left-turn movement from the eastbound Route 460 left-turn movement to northbound Campbell Avenue both currently operate at LOS D. During the PM peak hour, two of the four intersections operate at LOS C or better. The unsignalized left-turn from the Route 460 eastbound off-ramp at Campbell Avenue currently operates at LOS E, and the Candlers Mountain Road and Mayflower Drive intersection currently operates at LOS D during the PM peak hour.

7.3. Future Traffic Operations

AM and PM peak hour operations were also analyzed using *HCS 2010*, *VISSIM*, *Synchro*, and *SimTraffic* for Opening Year (2016) and Design Year (2035) No Build and Build conditions. These results were used to identify future capacity deficiencies and to ensure that the proposed Build Alternative would provide acceptable operations and address the project needs identified in Chapter 1.

At this time, no additional significant capacity improvements are funded for Route 460 within the project Study Area. Therefore both the No Build and Build Alternatives assume no additional capacity on Route 460 through Design Year 2035.

7.3.1. Analysis of No-Build Conditions

7.3.1.1. 2016 No-Build

Freeway Segments: The *HCS 2010* results for the Route 460 and Business Route 29 freeway corridors within the Study Area are summarized in Table 7-6. Figure 7-2 summarizes the operating characteristics at the analysis points within the study area for the entire network for both the AM and PM peak hours.

Table 7-6. 2016 No Build Operational Performance of the Freeway Segments

Route	Location	Direction	HCS 2010 Results			
			Density (pc/mi/lane)		LOS	
			AM Peak	PM Peak	AM Peak	PM Peak
Route 460	West of Candler Mountain Road	EB	18.3	12.6	C	B
		WB	15.0	19.6	B	C
Route 460	Candler Mountain Road to Campbell Avenue	EB	13.5	15.3	B	B
		WB	18.4	16.7	C	B
Route 460	East of Campbell Avenue	EB	11.8	14.1	B	B
		WB	17.9	13.9	B	B
Business Route 29	North of Odd Fellows Road	NB	19.1	15.6	C	B
		SB	18.7	16.1	C	B
Business Route 29	South of Odd Fellows Road	NB	20.4	15.1	C	B
		SB	17.7	17.5	B	B

The HCS analysis results in Table 7-6 indicate densities between fourteen (14) and twenty (20) passenger cars per mile per lane along the Route 460 corridor. Overall, these densities indicate acceptable operations (LOS C or better) during the AM and PM peak periods along both freeway corridors.

Ramp Junctions: Capacity analyses were also conducted using *HCS 2010* for the ramp junctions along Route 460, Business Route 29, and Candler Mountain Road. The results of the ramp junction analysis are summarized in Table 7-7 for Route 460 and the results for Business Route 29 are summarized in Table 7-8.

Table 7-7. 2016 No Build Operational Performance - Ramp Junctions (Route 460)

Ramp	HCS 2010 Results			
	Density (pc/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Candlers Mountain Road Eastbound Off-Ramp	22.2	15.3	C	B
Candlers Mountain Road Eastbound On-Ramp	16.0	17.6	B	B
Candlers Mountain Road Westbound Off-Ramp	24.2	22.0	C	C
Candlers Mountain Road Westbound On-Ramp	18.5	23.1	B	C
Campbell Avenue Eastbound Off-Ramp	17.8	19.9	B	B
Campbell Avenue Southbound to Eastbound On-Ramp	15.7	18.2	B	B
Campbell Avenue Northbound to Eastbound On-Ramp	15.6	18.1	B	B
Campbell Avenue Westbound Off-Ramp	22.2	17.3	C	B
Campbell Avenue Westbound On-Ramp	23.1	20.9	C	C

Table 7-8. 2016 No Build Operational Performance - Ramp Junctions (Business Route 29)

Ramp	HCS 2010 Results			
	Density (pc/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Odd Fellows Road Northbound Off-Ramp	24.2	18.3	C	B
Odd Fellows Road Northbound On-Ramp	22.7	17.9	C	B
Odd Fellows Road Southbound Off-Ramp	21.3	18.4	C	B
Odd Fellows Road Southbound On-Ramp	21.8	22.5	C	C

The HCS results indicate densities ranging from approximately seventeen (17) to twenty-two (22) passenger cars per mile per lane within the various ramp merge and diverge areas along Route 460. Along Business Route 29, the analysis results indicate densities ranging from twenty-one (21) and twenty-seven (27) passenger cars per mile per lane. These densities indicate uncongested operations (LOS B / LOS C) during the AM and PM peak periods along both freeways.

Table 7-9. 2016 No Build Operational Performance - Ramp Junctions (Candlers Mountain Road)

Ramp	HCS 2010 Results			
	Density (pc/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Candlers Mountain Shopping Center	24.8	18.9	C	B

The HCS analysis results indicate densities of approximately nineteen (19) and twenty-five (25) passenger cars per mile per lane for the ramp along Candlers Mountain Road. These densities indicate acceptable operations (LOS B / LOS C) during the AM and PM peak period along Candlers Mountain Road.

Figure 7-2 summarizes the 2016 No Build freeway and ramp junction traffic operations.

Intersections: *Synchro* and *SimTraffic* were utilized to assess the operations of the intersections within the Study Area along Candlers Mountain Road, Odd Fellows Road, and Campbell Avenue. The intersections analyzed for the No Build condition are the following:

- Candlers Mountain Road at Mayflower Drive (signalized)
- Campbell Avenue at Eastbound Off-Ramp (unsignalized)
- Campbell Avenue at Westbound Ramp Terminals (signalized)

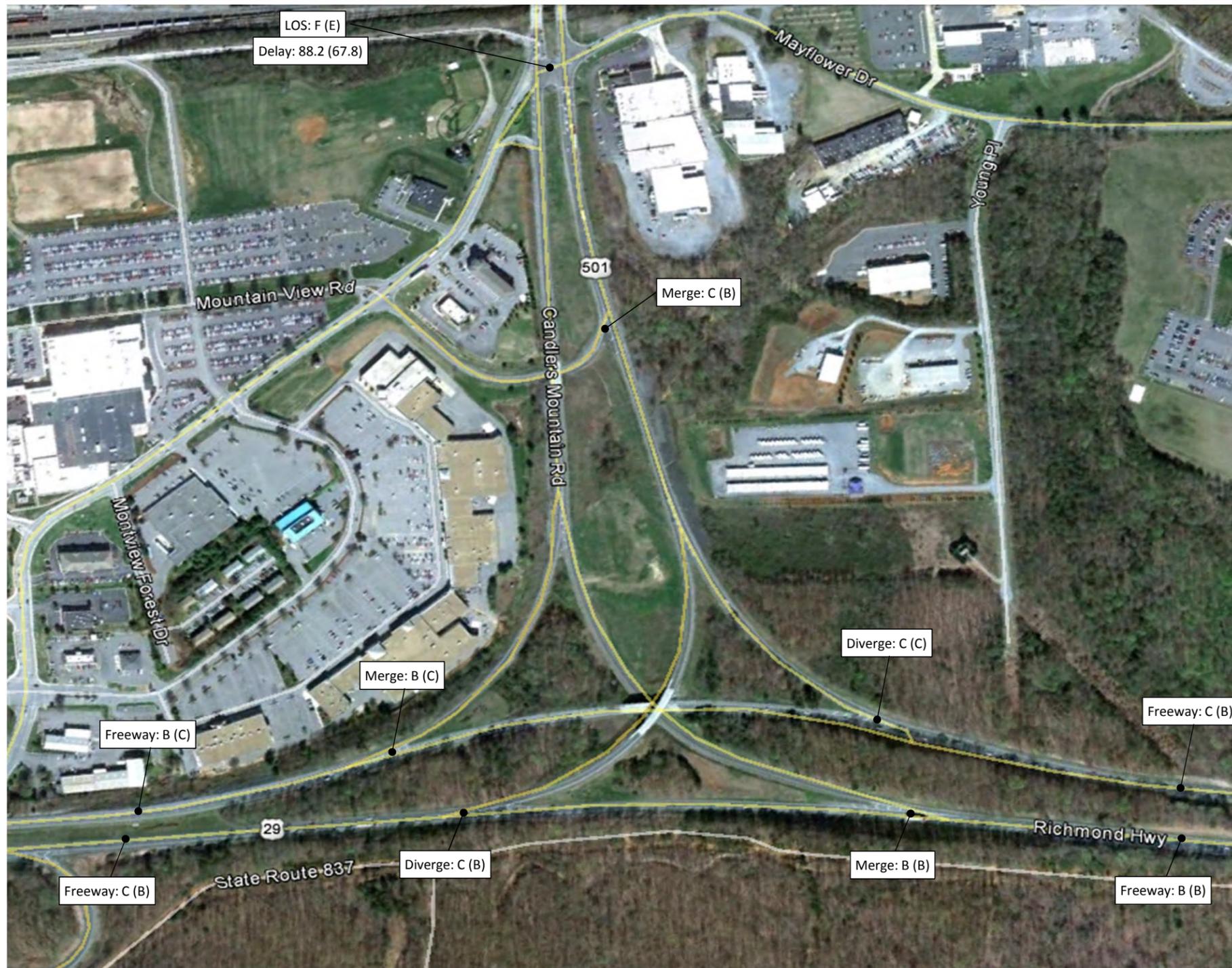


Figure 7-2
2016 No Build Opening Year AM (PM) Level of Service
Sheet 1 of 4



Figure 7-2
 2016 No Build Opening Year AM (PM) Level of Service
 Sheet 2 of 4



Figure 7-2
2016 No Build Opening Year AM (PM) Level of Service

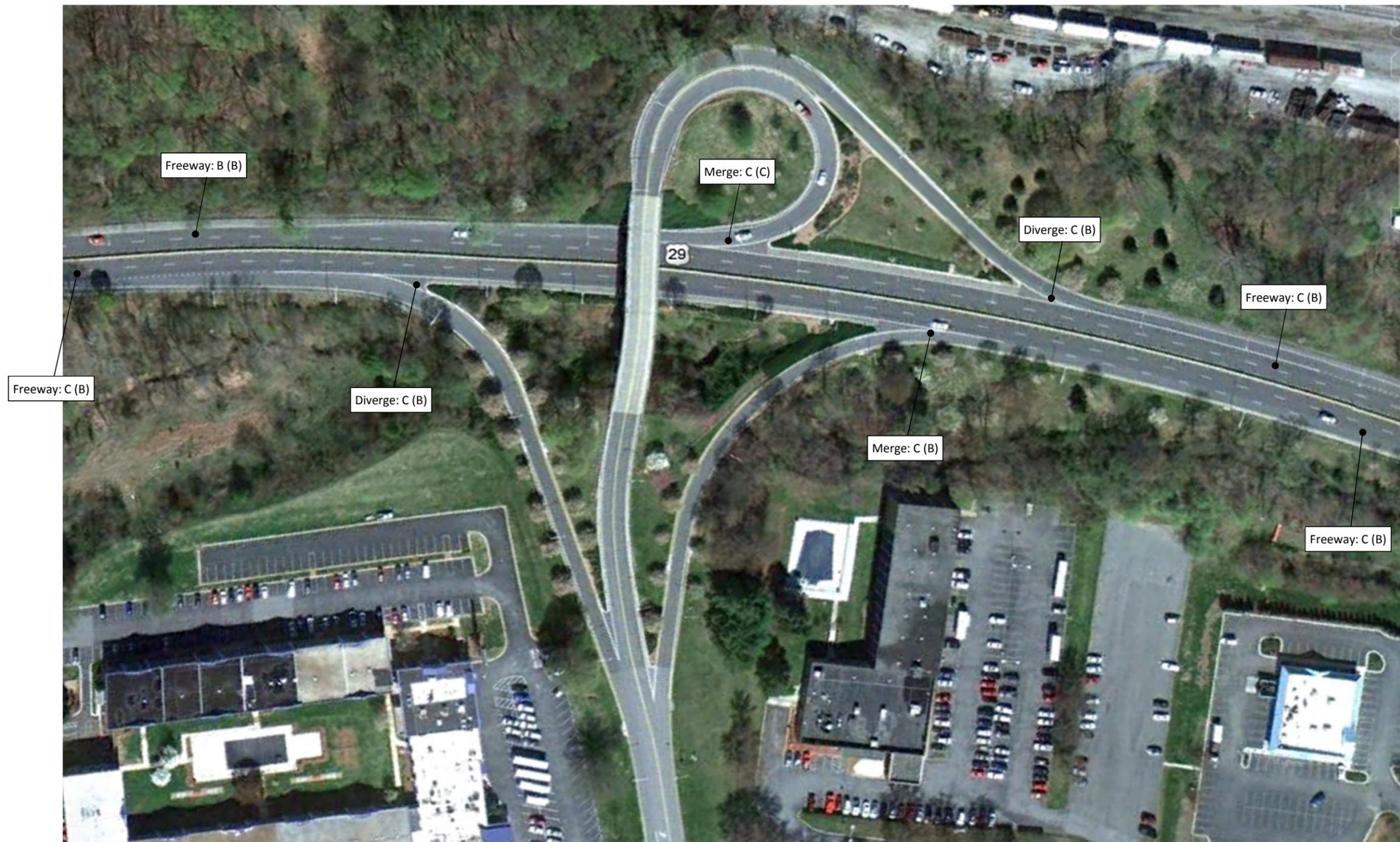


Figure 7-2
2016 No Build Opening Year AM (PM) Level of Service

- Odd Fellows Road at Mayflower Drive (signalized)

Levels of Service and delay are reported from the HCM Signals Report within *Synchro*. The maximum queues are reported from an average of five (5) simulation runs in *SimTraffic*. Table 7-10 summarizes the average AM and PM peak hour delay and maximum queues for each lane group at all Study Area intersections.

Table 7-10. 2016 No Build Intersection Operations

Intersection	Movement	AM			PM		
		Delay (sec/veh)	Maximum Queue (ft)	LOS	Delay (sec/veh)	Maximum Queue (ft)	LOS
Candlers Mountain Road at Mayflower Drive	NB Left	121.6	325	F	33.0	325	C
	NB Thru	23.8	515	C	33.5	520	C
	NB Right	12.1	370	B	16.0	405	B
	SB Left	32.6	690	C	29.9	690	C
	SB Thru	165.5	635*	F	97.1	635*	F
	SB Right						
	WB Left	111.9	575	F	117.1	910	F
	WB Thru						
	WB Right	41.4	245	D	37.9	210	D
ALL	88.2	-	F	67.8	-	E	
Odd Fellows Road at Mayflower Drive	EB Left	21.0	150	C	18.5	150	B
	EB Thru	16.1	535	B	15.5	215	B
	EB Right						
	WB Left	34.5	60	C	-	-	-
	WB Thru	42.2	240	D	36.9	130	D
	WB Right						
	NB Left	59.5	140	E	35.9	85	D
	NB Thru	69.2	215	E	39.3	120	D
	NB Right						
	SB Left	38.6	510	D	39.5	250	D
	SB Thru						
SB Right							
ALL	34.5	-	C	31.1	-	C	
Campbell Avenue at Route 460 Eastbound Off-Ramp	EB Left	121.2	735	F	185.7	335	F
	EB Right						
	NB Thru	Free-Flow			Free-Flow		
	SB Thru	Free-Flow			Free-Flow		
	ALL	-	-	-	-	-	-
Campbell Avenue at Route 460 Westbound Ramps	WB Left	34.2	105	C	66.2	215	E
	WB Right	56.4	-	E	53.1	-	D
	NB Left	12.0	125	B	13.7	110	B
	NB Thru	9.7	105	A	3.6	85	A
	SB Thru	20.2	205	C	15.1	350	B
	SB Right						
ALL	22.5	-	C	18.2	-	B	

*Queue exceeds available storage to upstream signalized intersection at Murray Place.

By 2016, unacceptable operations (LOS E / F) are projected at the Candler's Mountain Road / Mayflower Drive intersection during both the AM and PM peak with long queues extending down Mayflower Drive in the AM and PM peak, and a long queue along Southbound Candler's Mountain Road in the PM peak.

Also by 2016, the operations at the Odd Fellows Road and Mayflower Drive intersection are projected to degrade to nearly LOS D during the AM peak hour. The northbound movements along Odd Fellows Road appear to be the most impacted by the increasing volumes at this intersection. The stop controlled left-turn movement at the Campbell Avenue and eastbound Route 460 off-ramp intersection is expected to operate at LOS F during both the AM and PM peaks.

Summary: By 2016, operations at the intersections within the local street network are projected to degrade from existing conditions. These poor operations will further inhibit access to the industrial areas north of Route 460. The results do indicate that Route 460 will operate with excess capacity during the peak hours, so alternatives which shift traffic from the local road system to the freeway system would be likely to better balance operations within the overall transportation system.

7.3.1.2. 2035 No-Build

Freeway Segments: The HCS 2010 and VISSIM analysis results for the Route 460 and Business Route 29 freeway corridors are summarized in Table 7-11. Figure 7-3 summarizes the analysis results for the Study Area for both the AM and PM peak hours.

Table 7-11. 2035 No Build Operational Performance of the Freeway Segments

Route	Location	Direction	HCS 2010 Results				VISSIM Results			
			Density (pc/mi/lane)		LOS		Density (veh/mi/lane)		LOS Range	
			AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Route 460	West of Candler's Mountain Road	EB	24.4	17.2	C	B	24.4	17.1	C	B
		WB	19.6	25.7	C	C	17.6	23.0	B	C
Route 460	Candler's Mountain Road to Campbell Avenue	EB	18.0	20.3	C	C	17.4	20.2	B	C
		WB	24.1	21.9	C	C	24.1	21.6	C	C
Route 460	East of Campbell Avenue	EB	15.3	18.2	B	C	14.9	18.2	B	C
		WB	24.1	18.9	C	C	23.3	18.0	C	C
Business Route 29	North of Odd Fellows Road	NB	22.0	18.0	C	B	20.4	17.9	C	B
		SB	21.5	18.5	C	C	18.5	19.1	C	C
Business Route 29	South of Odd Fellows Road	NB	23.6	17.4	C	B	20.0	17.8	C	B
		SB	20.4	20.1	C	C	18.8	19.8	C	C

The HCS analysis results in Table 7-11 indicate densities between fifteen (15) and twenty-four (24) passenger cars per mile per lane along the Route 460 corridor. Overall, these densities indicate acceptable operations (LOS C or better) during the AM and PM peak periods along both freeway

corridors. The *VISSIM* analysis results indicate similar or slightly better operations than the HCS analysis, with the freeway segments expected to operate in the LOS B/C range. These analyses show that the freeway segments are expected to operate acceptably under 2035 No Build conditions.

Ramp Junctions: Capacity analyses were also conducted using both *HCS 2010* and *VISSIM* for the ramp junctions along Route 460, Business Route 29, and Candler's Mountain Road. The results of the ramp junction analysis are summarized in Table 7-12 for Route 460, Table 7-13 for Business Route 29, and Table 7-14 for Candler's Mountain Road.

Table 7-12. 2035 No Build Operational Performance - Ramp Junctions (Route 460)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Candler's Mountain Road Eastbound Off-Ramp	29.1	20.9	D	C	18.4	14.1	B	B
Candler's Mountain Road Eastbound On-Ramp	20.8	23.0	C	C	16.8	19.1	B	B
Candler's Mountain Road Westbound Off-Ramp	30.6	28.3	D	D	20.2	18.5	C	B
Candler's Mountain Road Westbound On-Ramp	23.5	29.1	C	D	18.4	22.9	B	C
Campbell Avenue Eastbound Off-Ramp	23.2	26.0	C	C	15.7	18.5	B	B
Campbell Avenue Southbound to Eastbound On-Ramp	21.0	25.6	C	C	14.2	17.4	B	B
Campbell Avenue Northbound to Eastbound On-Ramp	19.5	22.6	B	C	14.9	18.3	B	B
Campbell Avenue Westbound Off-Ramp	29.3	23.4	D	C	20.8	16.6	C	B
Campbell Avenue Westbound On-Ramp	28.9	26.4	D	C	22.7	20.3	C	C

Table 7-13. 2035 No Build Operational Performance - Ramp Junctions (Business Route 29)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Odd Fellows Road Northbound Off-Ramp	27.7	20.8	C	C	20.0	17.8	C	B
Odd Fellows Road Northbound On-Ramp	25.8	20.3	C	C	19.9	17.7	B	B
Odd Fellows Road Southbound Off-Ramp	24.5	21.1	C	C	16.7	17.7	B	B
Odd Fellows Road Southbound On-Ramp	24.6	25.4	C	C	19.7	20.6	B	C

Table 7-14. 2035 No Build Operational Performance - Ramp Junctions (Candlers Mountain Road)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Candlers Mountain Shopping Center	29.6	22.4	D	C	65.3	28.8	F	D

The results of the HCS analysis indicate densities ranging from approximately nineteen (19) to twenty-nine (29) passenger cars per mile per lane within the various ramp merge and diverge areas along Route 460. Along Business Route 29, the analysis results indicate densities ranging from twenty-one (21) and twenty-eight (28) passenger cars per mile per lane. Along Route 460, some degradation in the Level of Service begins to occur at both the Candlers Mountain Road and Campbell Avenue interchanges, particularly in the westbound direction. In the AM peak it is projected that the westbound ramps at Campbell Avenue will operate at LOS D, as well as the eastbound and westbound off-ramps to Candlers Mountain Road. In the PM peak, both westbound ramps at Candlers Mountain Road are expected to operate at LOS D. Along Business Route 29, the densities indicate acceptable LOS C or better operations during the AM and PM peak periods. Figure 7-3 summarizes the 2035 No Build freeway and ramp junction traffic operations.

Intersections: *Synchro* and *SimTraffic* were utilized to assess the operations of the four key (4) intersections within the Study Area. Levels of Service and delay are reported from the HCM Signals Report within *Synchro*. The maximum queues are reported from an average of five (5) simulation runs in *SimTraffic*. Table 7-15 summarizes the average AM and PM peak hour delay and maximum queues for each lane group at all Study Area intersections.

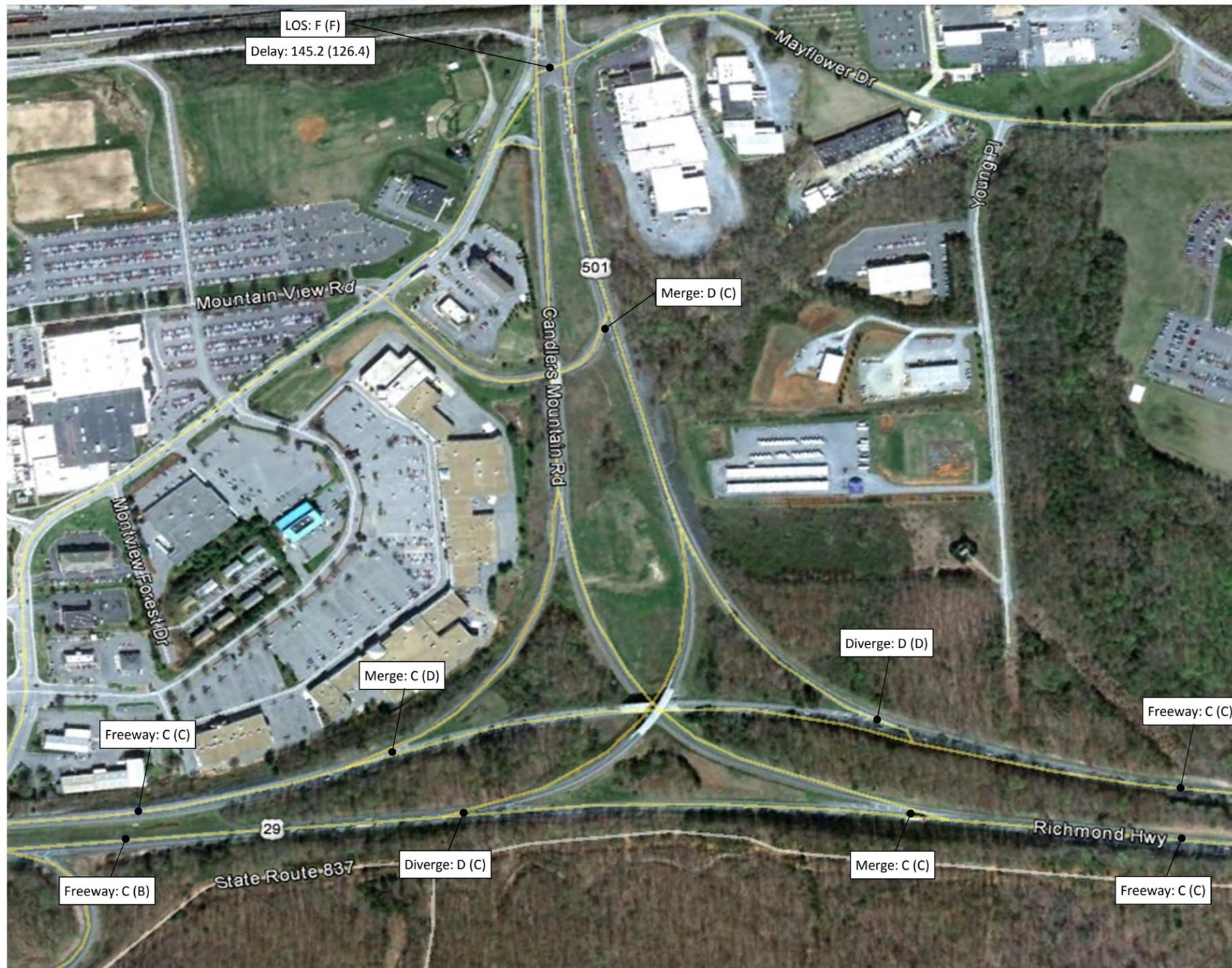


Figure 7-3
2035 No Build Design Year AM (PM) Level of Service
Sheet 1 of 4



Figure 7-3
 2035 No Build Design Year AM (PM) Level of Service
 Sheet 2 of 4



Figure 7-3
2035 No Build Design Year AM (PM) Level of Service
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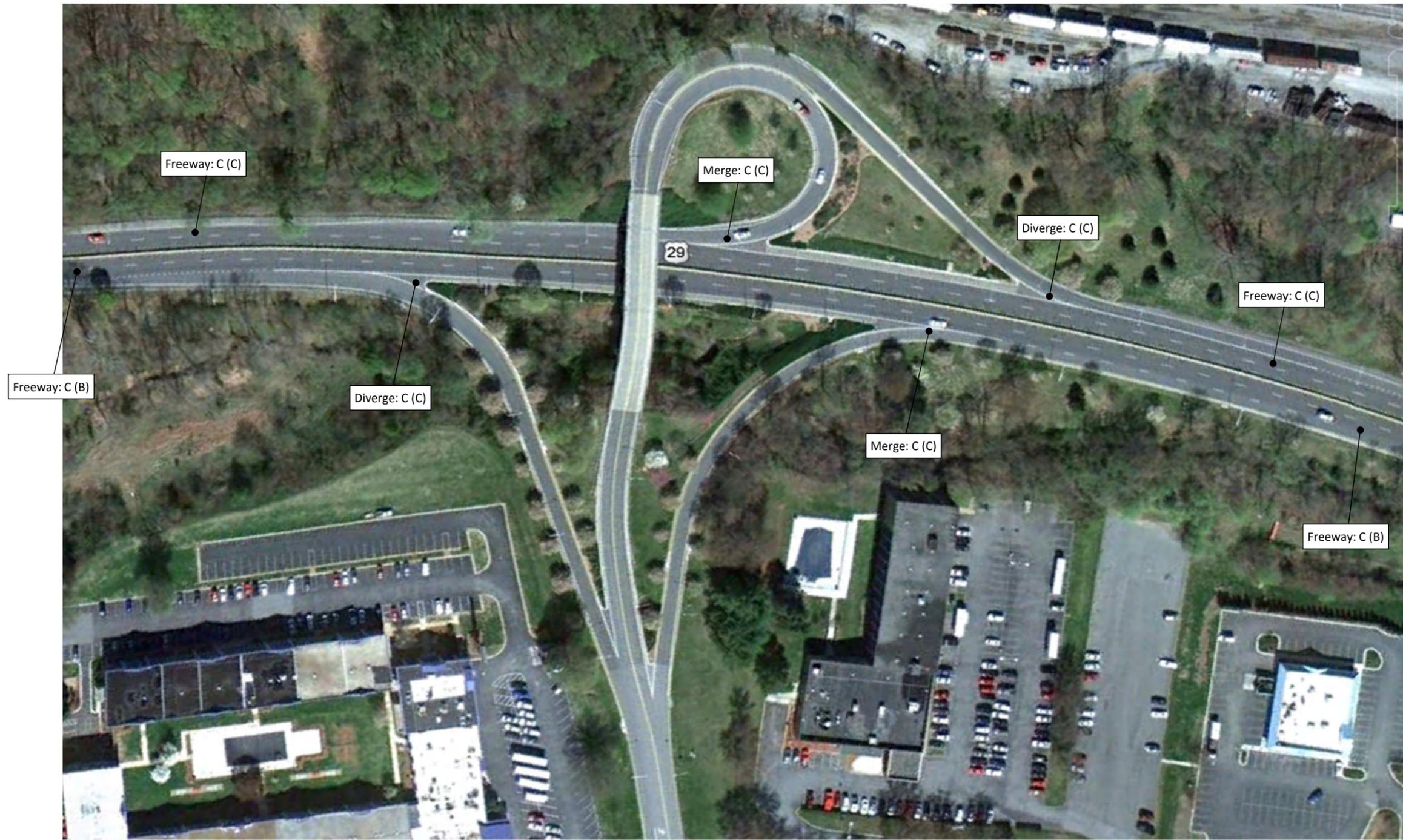


Figure 7-3
 2035 No Build Design Year AM (PM) Level of Service
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Table 7-15. 2035 No Build Intersection Operations

Intersection	Movement	AM			PM		
		Delay (sec/veh)	Maximum Queue (ft)	LOS	Delay (sec/veh)	Maximum Queue (ft)	LOS
Candlers Mountain Road at Mayflower Drive	NB Left	265.5	325	F	33.9	325	C
	NB Thru	37.0	530	D	66.8	540	E
	NB Right	9.9	405	A	14.9	405	B
	SB Left	134.1	685	F	54.2	685	D
	SB Thru	254.7	635*	F	185.1	635*	F
	SB Right						
	WB Left	219.2	910	F	213.3	940	F
	WB Thru						
	WB Right	43.2	280	D	41.1	280	D
ALL	145.2	-	F	126.4	-	F	
Odd Fellows Road at Mayflower Drive	EB Left	33.4	150	C	26.3	150	C
	EB Thru	21.6	630	C	19.7	375	B
	EB Right						
	WB Left	42.2	80	D	40.0	40	D
	WB Thru	54.1	210	D	45.8	165	D
	WB Right						
	NB Left	57.2	140	E	42.3	100	D
	NB Thru	58.7	185	E	49.0	200	D
	NB Right						
	SB Left	52.2	570	D	47.2	485	D
	SB Thru						
SB Right							
ALL	44.6	-	D	38.9	-	D	
Campbell Avenue at Route 460 Eastbound Off-Ramp	EB Left	430.1	940	F	643.1	935	F
	EB Right						
	NB Thru	Free-Flow			Free-Flow		
	SB Thru	Free-Flow			Free-Flow		
	ALL	-	-	-	-	-	-
Campbell Avenue at Route 460 Westbound Ramps	WB Left	24.2	125	C	68.6	260	E
	WB Right	60.6	-	E	50.7	-	D
	NB Left	37.8	140	D	45.3	-	D
	NB Thru	19.2	125	B	4.6	100	A
	SB Thru	42.8	175	D	21.9	435	C
	SB Right						
ALL	36.8	-	D	25.1	-	C	

*Queue exceeds available storage to upstream signalized intersection at Murray Place.

By 2035 it is expected that only the Campbell Avenue and westbound Route 460 ramp terminal intersection will operate at LOS C or better overall in the PM peak hour. The Candlers Mountain Road / Mayflower Drive intersection is projected to continue to operate with excessive delays for multiple movements (200+ seconds per vehicle), and lengthy queues along both Mayflower Drive and southbound Candlers Mountain Road. By 2035, the Odd Fellows Road at Mayflower Drive intersection is projected to operate at LOS D during both peaks. Lastly, it is expected that by 2035 the queues and delays along the eastbound off-ramp at Campbell Avenue will produce failing operations with projected

maximum queues in the 500 to 600 foot range along the ramp. It should be noted that the existing off-ramp is long enough to accommodate these projected queues.

Summary: In 2035, the trends observed in the 2016 No Build analysis are projected to continue. The intersections within the local street network are projected to operate poorly during the peak hours, with increases in delay and queues impacting access to the Mayflower Drive / Odd Fellows Road area. While traffic growth is projected to continue along Route 460, the results continue to indicate that Route 460 will operate with excess capacity during the peak hours, so alternatives which shift traffic from the local road system to the freeway system would better balance operations within the overall transportation system.

7.3.2. Analysis of Build Conditions

VDOT is proposing to construct an interchange along Route 460 at Odd Fellows Road to address safety and operational deficiencies caused by the existing traffic patterns associated with the truck traffic attempting to access businesses along Mayflower Drive and Odd Fellows Road. The proposed interchange will be a diamond design (see Chapter 4 for details on the selection of the preferred design concept) between Route 460 and Odd Fellows Road and will be located approximately midway along Route 460 between Candler's Mountain Road and Campbell Avenue. These ramps will terminate at Odd Fellows Road with two unsignalized intersections.

Odd Fellows Road will be widened to meet VDOT standards near its current terminus and then extended south to the interchange. South of the interchange, VDOT plans to construct a stub-out which connects to a proposed single-lane roundabout intersection. It is anticipated that Top Ridge Road will be relocated by others to connect to the roundabout intersection from the east and west. Future potential development south of the interchange has been included in the Build Condition traffic forecasts for the Opening and Design Years for this IJR, as discussed in Chapter 6.

The following sections document the analysis of the freeway, ramp, and intersections with the Preferred Build Alternative in place.

7.3.2.1. 2016 Build Year

Freeway Segments: Since no additional capacity is being provided along Route 460 or Business Route 29 as part of the Build Alternative for this project, the HCS inputs are similar to those utilized for the 2016 No Build conditions. However, the overall traffic patterns in the Study Area are expected to shift due to the proposed Route 460 / Odd Fellows Road interchange. These expected shifts are discussed in greater detail in Chapter 6. These results take into account the adjusted volumes for the Build Condition. The analysis results are provided in Table 7-16 and Figure 7-4.

Table 7-16. 2016 Build Operational Performance Freeway Segments

Route	Location	Direction	HCS 2010 Results			
			Density (pc/mi/lane)		LOS	
			AM Peak	PM Peak	AM Peak	PM Peak
Route 460	West of Candler's Mountain Road	EB	19.5	14.4	C	B
		WB	17.4	21.7	B	C
Route 460	Candler's Mountain Road to Odd Fellows Road	EB	15.3	16.8	B	B
		WB	20.9	18.1	C	C
Route 460	Odd Fellows Road to Campbell Avenue	EB	14.5	17.3	B	B
		WB	20.6	19.1	C	C
Route 460	East of Campbell Avenue	EB	12.8	15.9	B	B
		WB	19.4	15.4	C	B
Business Route 29	North of Odd Fellows Road	NB	20.2	16.3	C	B
		SB	20.1	17.2	C	B
Business Route 29	South of Odd Fellows Road	NB	20.6	15.3	C	B
		SB	17.9	17.6	B	B

Similar to the 2016 No Build results, the HCS analysis results in Table 7-16 indicate densities between fourteen (14) and twenty (20) passenger cars per mile per lane along the Route 460 corridor. Overall, these densities indicate acceptable operations (LOS C or better) during the AM and PM peak periods along both freeway corridors.

Ramp Junctions: Capacity analyses were also conducted using *HCS 2010* for the ramp junctions along Route 460 (including the proposed Odd Fellows Road ramps), Business Route 29, and Candler's Mountain Road. The results of the ramp junction analyses are summarized in Table 7-17 for Route 460, Table 7-18 for Business Route 29, and Table 7-19 for Candler's Mountain Road.

Table 7-17. 2016 Build Operational Performance - Ramp Junctions (Route 460)

	HCS 2010 Results			
	Density (pc/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Candler's Mountain Road Eastbound Off-Ramp	23.7	17.5	C	B
Candler's Mountain Road Eastbound On-Ramp	17.9	19.3	B	B
Candler's Mountain Road Westbound Off-Ramp	26.8	25.0	C	C
Candler's Mountain Road Westbound On-Ramp	21.1	25.4	C	C
Odd Fellows Road Eastbound Off-Ramp*	14.5	16.4	B	B
Odd Fellows Road Eastbound On-Ramp*	15.7	18.6	B	B
Odd Fellows Road Westbound Off-Ramp*	17.7	14.4	B	B
Odd Fellows Road Westbound On-Ramp*	21.2	20.5	C	C
Campbell Avenue Eastbound Off-Ramp	19.0	22.3	B	C
Campbell Avenue Southbound to Eastbound On-Ramp	16.7	20.1	B	C
Campbell Avenue Northbound to Eastbound On-Ramp	16.7	20.0	B	C
Campbell Avenue Westbound Off-Ramp	24.1	19.1	C	B
Campbell Avenue Westbound On-Ramp	25.8	22.5	C	C

***Proposed New Interchange Ramp**

Table 7-18. 2016 Build Operational Performance - Ramp Junctions (Business Route 29)

Ramp	HCS 2010 Results			
	Density (pc/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Odd Fellows Road Northbound Off-Ramp	24.5	18.4	C	B
Odd Fellows Road Northbound On-Ramp	24.7	18.7	C	B
Odd Fellows Road Southbound Off-Ramp	22.8	19.7	C	B
Odd Fellows Road Southbound On-Ramp	22.1	22.8	C	C

Table 7-19. 2016 Build Operational Performance - Ramp Junctions (Candlers Mountain Road)

Ramp	HCS 2010 Results			
	Density (pc/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
Candlers Mountain Shopping Center	23.4	18.1	C	B

The HCS analysis results indicate densities ranging from approximately fourteen (14) to twenty-six (26) passenger cars per mile per lane within the various ramp merge and diverge areas along Route 460. Along Business Route 29, the analysis results indicate densities ranging from eighteen (18) and twenty-five (25) passenger cars per mile per lane. These densities indicate acceptable operations (LOS B / LOS C) during the AM and PM peak periods along both freeways. Notably, at the proposed Route 460 / Odd Fellows Road interchange all ramps are expected to operate acceptably (LOS C or better) in the Opening Year. Figure 7-4 summarizes the 2016 Build freeway segments, and ramp junction area traffic operations.

Intersections: *Synchro* and *SimTraffic* were utilized to assess the operations of six (6) key intersections within the Study Area. The intersections analyzed include the four intersections analyzed for the No Build condition plus the two proposed Route 460 ramp terminal intersections along Odd Fellows Road. Levels of Service and delay are reported from the HCM Signals Report within *Synchro*. The maximum queues are reported from an average of five (5) simulation runs in *SimTraffic*. Table 7-20 summarizes the average AM and PM peak hour delay and maximum queues for each lane group at the four existing Study Area intersections.

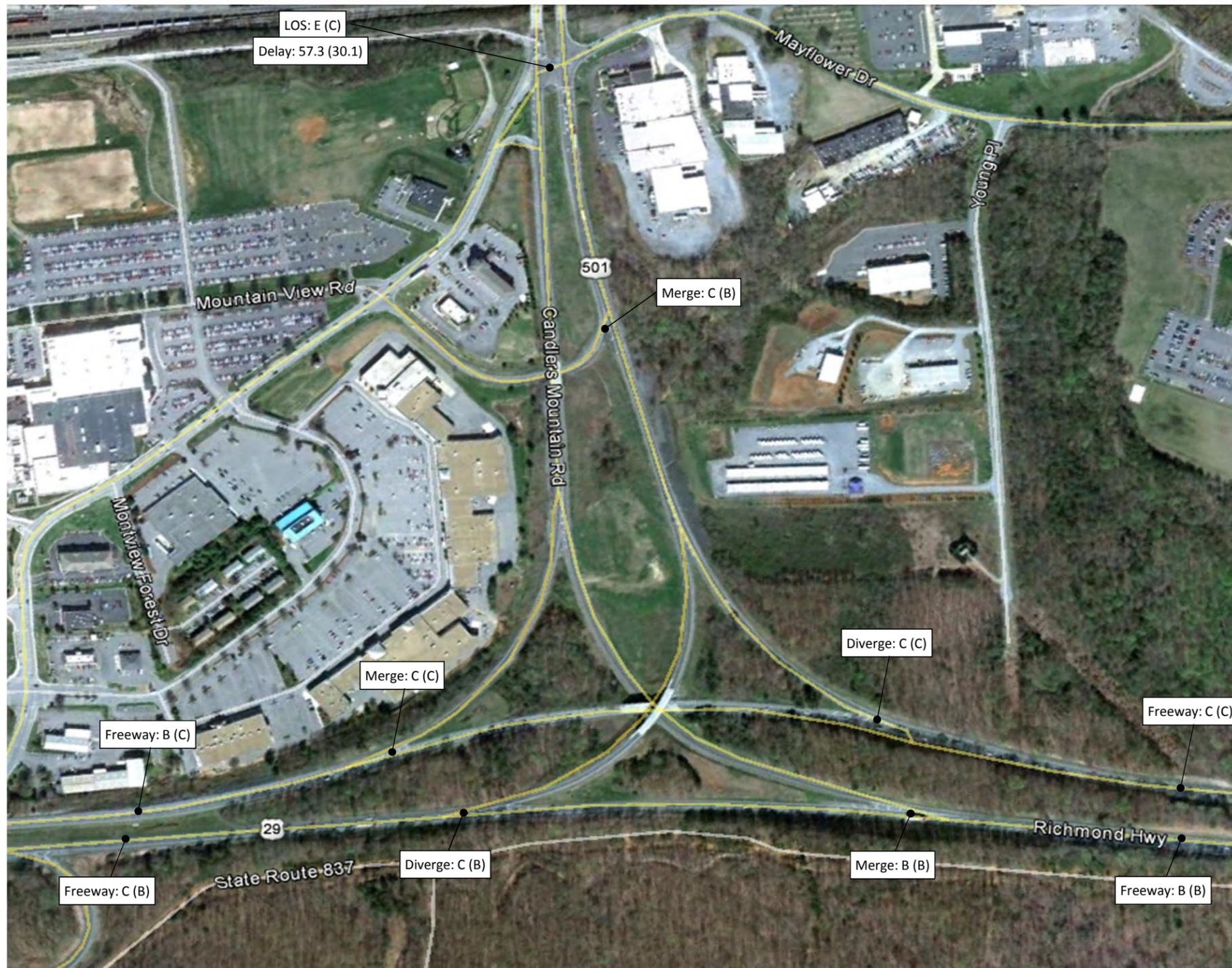


Figure 7-4
2016 Build Opening Year AM (PM) Level of Service
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Figure 7-4
 2016 Build Opening Year AM (PM) Level of Service
 Sheet 2 of 5



Figure 7-4
 2016 Build Opening Year AM (PM) Level of Service
 Sheet 3 of 5



Figure 7-4
2016 Build Opening Year AM (PM) Level of Service
Sheet 4 of 5

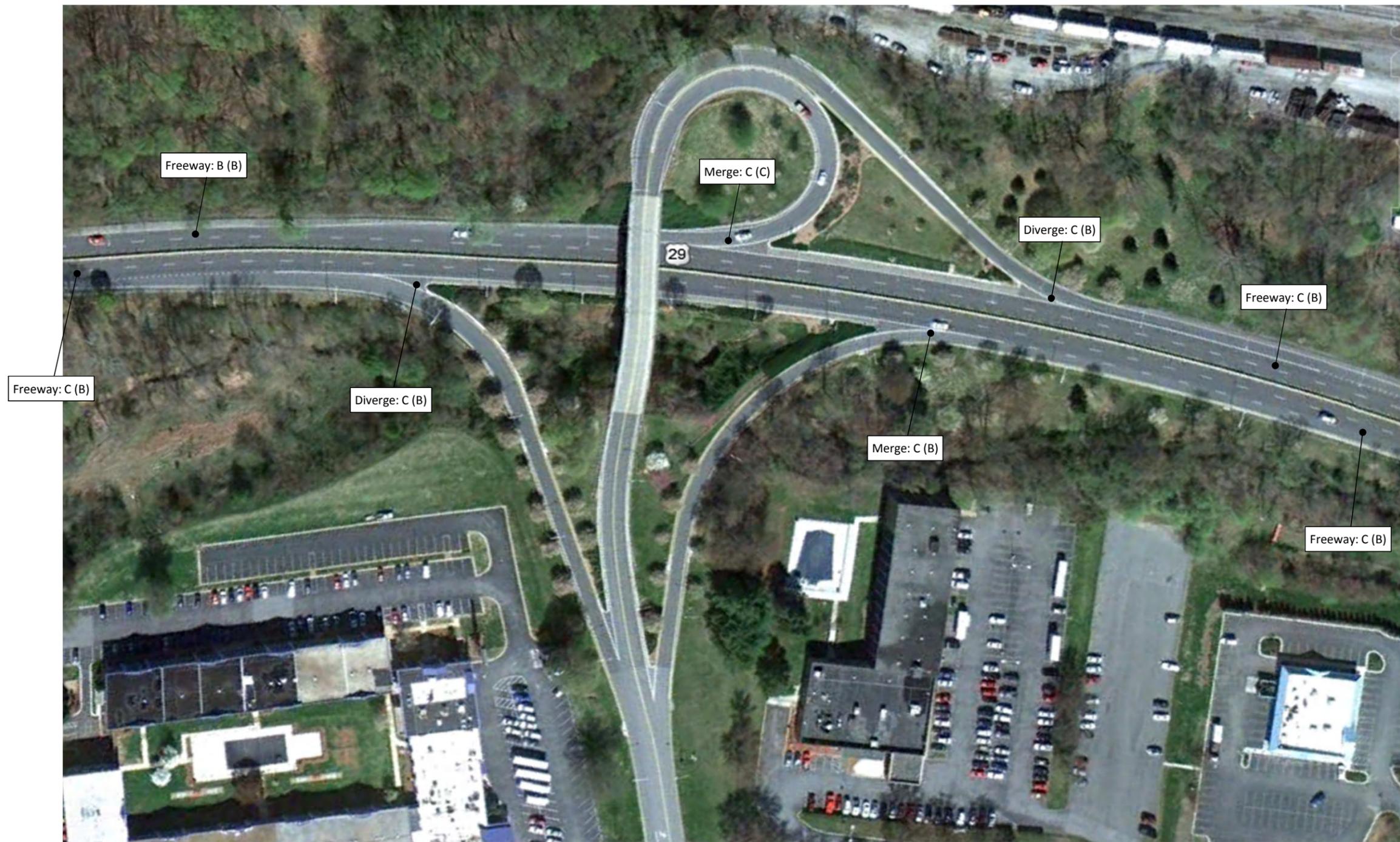


Figure 7-4
2016 Build Opening Year AM (PM) Level of Service
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Table 7-20. 2016 Build - Intersection Operations

Intersection	Movement	AM			PM		
		Delay (sec/veh)	Maximum Queue (ft)	LOS	Delay (sec/veh)	Maximum Queue (ft)	LOS
Candlers Mountain Road at Mayflower Drive	NB Left	108.8	275	F	31.1	165	C
	NB Thru	15.3	515	B	19.7	500	B
	NB Right	7.5	290	A	9.7	80	A
	SB Left	24.2	670	C	19.0	495	B
	SB Thru	92.7	635*	F	32.0	635*	C
	SB Right						
	WB Left	125.1	420	F	85.9	720	F
	WB Thru						
	WB Right	47.3	230	D	47.9	280	D
ALL	57.3	-	E	30.1	-	C	
Odd Fellows Road at Mayflower Drive	EB Left	96.2	150	F	62.0	150	E
	EB Thru	42.5	620	D	37.5	415	D
	EB Right						
	WB Left	66.8	45	E	-	-	-
	WB Thru	63.1	75	E	58.7	60	E
	WB Right						
	NB Left	45.5	150	D	39.9	150	D
	NB Thru	104.2	665	F	63.9	505	E
	NB Right						
	SB Left	68.3	560	E	53.1	540	D
	SB Thru						
SB Right							
ALL	77.6	-	E	55.5	-	E	
Campbell Avenue at Route 460 Eastbound Off-Ramp	EB Left	31.1	370	D	32.3	255	D
	EB Right						
	NB Thru	Free-Flow			Free-Flow		
	SB Thru	Free-Flow			Free-Flow		
	ALL	-	-	-	-	-	-
Campbell Avenue at Route 460 Westbound Ramp Terminals	WB Left	45.1	110	D	66.7	190	E
	WB Right	56.7	-	E	53.1	-	D
	NB Left	5.9	145	A	10.7	120	B
	NB Thru	4.3	95	A	3.4	70	A
	SB Thru	13.4	120	B	13.5	280	B
	SB Right						
ALL	17.8	-	B	17.7	-	B	

*Queue exceeds available storage to upstream signalized intersection at Murray Place.

Compared with the No Build results presented in Table 7-10, delays at the Candlers Mountain Road and Mayflower Drive intersection would be reduced by 35 percent in the AM peak and 56 percent in the PM peak. At Odd Fellows Road and Mayflower Drive, the intersection is expected to degrade from LOS C in to LOS E in both peaks; this degradation is due to an increase in northbound and southbound thru traffic along Odd Fellows Road travelling between Business Route 29 and Route 460 (to access the new interchange). Two potential improvement options have been identified for this intersection; these options would mitigate the increase in delay projected at this intersection under the Build Alternative (see Section 7.4).

Analyses were also conducted for the proposed Route 460 ramp terminal intersections along Odd Fellows Road. As noted in Chapter 4, the ramp terminal intersections are proposed to be stop-controlled as signalization is not projected to be warranted based on the anticipated traffic volumes at the interchange. *SimTraffic* was used to evaluate the Level of Service, delays, and queues at the ramp terminal intersections.

Table 7-21. 2016 Build – Route 460 / Odd Fellows Road Ramp Intersection Operations (*SimTraffic*)

Intersection	Movement	AM			PM		
		Delay (sec/veh)	Maximum Queue (ft)	LOS	Delay (sec/veh)	Maximum Queue (ft)	LOS
Odd Fellows Road at Eastbound Ramp Terminals	EB Left	12.3	135	B	15.8	120	B
	EB Right	4.6	85	A	8.0	100	A
	NB Thru	-	-	-	-	-	-
	NB Right	-	-	-	-	-	-
	SB Left	4.2	65	A	5.4	95	A
	SB Thru	-	-	-	-	-	-
	ALL	-	-	-	-	-	-
Odd Fellows Road at Westbound Ramp Terminals	WB Left	15.2	155	B	16.8	145	B
	WB Right	4.7	80	A	8.0	60	A
	NB Left	4.4	75	A	5.3	90	A
	NB Thru	-	-	-	-	-	-
	SB Thru	-	-	-	-	-	-
	SB Right	-	-	-	-	-	-
	ALL	-	-	-	-	-	-

The results in Table 7-21 indicate that the proposed ramp terminals are projected to operate acceptably during both peak hours in the Opening Year (2016). Each movement would operate at LOS B or better; which satisfies the FHWA Level of Service Design Criteria for the National Highway System.

The proposed storage for the left-turns along the off-ramps is 350 feet on both the eastbound and westbound ramps; therefore, the maximum queues, which range from approximately 120 to 200 feet, would be contained within the proposed storage along the off-ramp. This indicates that during day-to-day operations, queues along the off-ramps at the proposed interchange would not back onto the Route 460 mainline, which would be an operational and safety concern.

Summary: In 2016, the proposed ramp junctions along Route 460 would operate at LOS C or better in both peak hours; the proposed ramp terminal intersections along Odd Fellows Road would operate at LOS B or better, with minimal queuing along the eastbound and westbound Route 460 off-ramps. Additionally, due to changes in traffic patterns within the Study Area, operations at the Candler Mountain Road / Mayflower Drive intersection are projected to improve from the No Build condition (overall reduction in delay ranging from 26 to 59 percent). These results indicate that the proposed interchange would function efficiently and help address the operational and access needs identified in Chapter 1.

7.3.2.2. 2035 Build Year

Freeway Segments: The freeway analysis results for the 2035 Build condition are provided in Table 7-22 and Figure 7-5.

Table 7-22. 2035 Build Operational Performance Freeway Segments

Route	Location	Direction	HCS 2010 Results				VISSIM Results			
			Density (pc/mi/lane)		LOS		Density (veh/mi/lane)		LOS Range	
			AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Route 460	West of Candler Mountain Road	EB	26.0	19.0	C	C	25.8	19.0	C	C
		WB	22.0	28.6	C	D	20.3	23.6	C	C
Route 460	Candler Mountain Road to Odd Fellows Road	EB	19.8	21.8	C	C	20.0	22.1	C	C
		WB	27.1	25.0	D	C	26.3	22.3	D	C
Route 460	Odd Fellows Road to Campbell Avenue	EB	18.8	22.3	C	C	19.7	22.3	C	C
		WB	27.6	23.6	D	C	25.9	20.7	C	C
Route 460	East of Campbell Avenue	EB	16.3	19.9	B	C	17.0	19.8	B	C
		WB	26.1	20.4	D	C	25.1	20.0	C	C
Business Route 29	North of Odd Fellows Road	NB	23.3	18.9	C	C	22.0	18.9	C	C
		SB	23.1	19.9	C	C	20.0	21.5	C	C
Business Route 29	South of Odd Fellows Road	NB	23.8	17.6	C	B	20.7	18.8	C	C
		SB	20.6	20.3	C	C	18.8	20.4	C	C

The HCS analysis results in Table 7-22 indicate densities between sixteen (16) and twenty-nine (29) passenger cars per mile per lane along the Route 460 corridor. Along Route 460, the three (3) westbound segments from east of Campbell Avenue to the off-ramp to Candler Mountain Road are expected to operate at LOS D in the Design Year (2035) during the AM peak hour. The densities projected for these segments are each approximately 27 pc/mi/ln; the LOS C / D threshold is 26 pc/mi/ln. With the exception of the westbound segment west of Candler Mountain Road (LOS D) during the PM peak hour, all other segments along Route 460 are expected to operate acceptably (LOS C or better) during the AM and PM peak periods. All segments along Business Route 29 are expected to operate acceptably (LOS C or better) during the AM and PM peak periods under the Build condition.

The VISSIM analysis results indicate very similar or slightly better operations than the HCS analysis, with the freeway segments expected to operate in the LOS B/C range, with one LOS D noted in the westbound direction between Odd Fellows Road and Candler Mountain Road during the AM peak. Again, the results indicate that the density for this segment only slightly exceeds (by 0.3 veh/mi/ln) the density which represents the LOS C / D threshold.

Ramp Junctions: Capacity analyses were also conducted using both *HCS 2010* and *VISSIM* for the ramp junctions along Route 460 (including the Odd Fellows Road ramps), Business Route 29, and Candler Mountain Road. The results of the ramp junction analysis are summarized in Table 7-23 for Route 460, Table 7-24 for Business Route 29, and Table 7-25 for Candler Mountain Road.

Table 7-23. 2035 Build Operational Performance - Ramp Junctions (Route 460)

	<i>HCS 2010 Results</i>				<i>VISSIM Results</i>			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Candlers Mountain Road Eastbound Off-Ramp	30.7	23.1	D	C	20.9	16.2	C	B
Candlers Mountain Road Eastbound On-Ramp	22.8	24.6	C	C	19.4	20.9	B	C
Candlers Mountain Road Westbound Off-Ramp	33.5	31.5	D	D	22.0	19.4	C	B
Candlers Mountain Road Westbound On-Ramp	26.1	31.4	C	D	21.1	23.8	C	C
Odd Fellows Road Eastbound Off-Ramp*	20.0	22.3	C	C	17.3	19.5	B	B
Odd Fellows Road Eastbound On-Ramp*	20.4	24.0	C	C	19.4	21.8	B	C
Odd Fellows Road Westbound Off-Ramp*	24.5	20.6	C	C	22.6	19.3	C	B
Odd Fellows Road Westbound On-Ramp*	26.9	26.3	C	C	25.8	21.8	C	C
Campbell Avenue Eastbound Off-Ramp	24.2	28.3	C	D	18.7	22.2	B	C
Campbell Avenue Southbound to Eastbound On-Ramp	20.5	24.5	C	C	16.5	19.9	B	B
Campbell Avenue Northbound to Eastbound On-Ramp	20.6	24.5	C	C	17.4	21.6	B	C
Campbell Avenue Westbound Off-Ramp	31.2	25.2	D	C	23.4	18.9	C	B
Campbell Avenue Westbound On-Ramp	31.8	28.1	D	D	24.8	19.9	C	B

*** Proposed New Interchange Ramp**

Table 7-24. 2035 Build Operational Performance - Ramp Junctions (Business Route 29)

Ramp	<i>HCS 2010 Results</i>				<i>VISSIM Results</i>			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Odd Fellows Road Northbound Off-Ramp	27.9	21.0	C	C	20.7	18.8	C	B
Odd Fellows Road Northbound On-Ramp	28.4	21.4	D	C	21.3	18.7	C	B
Odd Fellows Road Southbound Off-Ramp	26.3	22.7	C	C	17.4	18.8	B	B
Odd Fellows Road Southbound On-Ramp	24.9	25.6	C	C	19.7	21.2	B	C

Table 7-25. 2035 Build Operational Performance - Ramp Junctions (Candlers Mountain Road)

Ramp	HCS 2010 Results				VISSIM Results			
	Density (pc/mi/ln)		LOS		Density (veh/mi/ln)		LOS	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Candlers Mountain Shopping Center	28.1	21.7	D	C	60.2	21.6	F	C

The HCS analysis results indicate densities ranging from approximately twenty (20) to thirty-two (32) passenger cars per mile per lane within the various ramp merge and diverge areas along Route 460. Along Business Route 29, the analysis results indicate densities ranging from twenty-one (21) to twenty-eight (28) passenger cars per mile per lane. With two exceptions, the ramps are expected to operate equal or better to the No Build condition. The exceptions are the Campbell Avenue westbound on-ramp in the PM peak, and the Odd Fellows Road northbound on-ramp at Business Route 29 in the AM peak. Both of these ramps saw increases in volume from the No Build condition due to the anticipated traffic shifts in the Study Area. No ramps junctions within the Study Area are projected to operate at LOS E or LOS F by the Design Year of 2035.

Notably, each of the proposed new ramp junctions along Route 460 at the Odd Fellows Road interchange are projected to operate at LOS C during both the AM and PM peak hours. Figure 7-5 summarizes the 2035 Build freeway and ramp junction traffic operations.

Intersections: *Synchro* and *SimTraffic* were utilized to assess the operations of seven (7) key intersections within the Study Area. Levels of Service and delay are reported from the HCM Signals Report within *Synchro*. The maximum queues are reported from an average of five (5) simulation runs in *SimTraffic*. Table 7-26 summarizes the average AM and PM peak hour delay and maximum queues for each lane group at the four existing Study Area intersections.

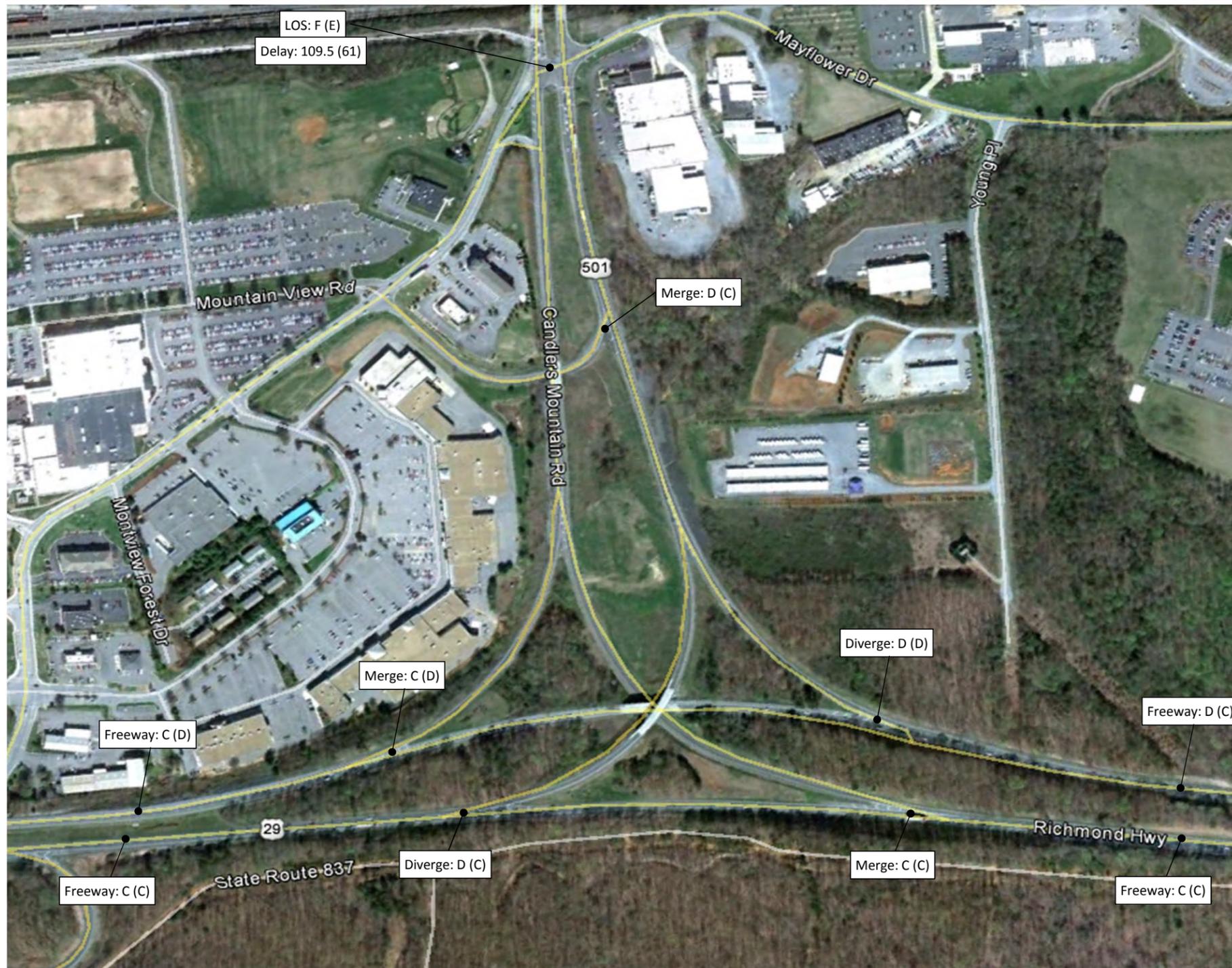


Figure 7-5
2035 Build Design Year AM (PM) Level of Service
Sheet 1 of 5

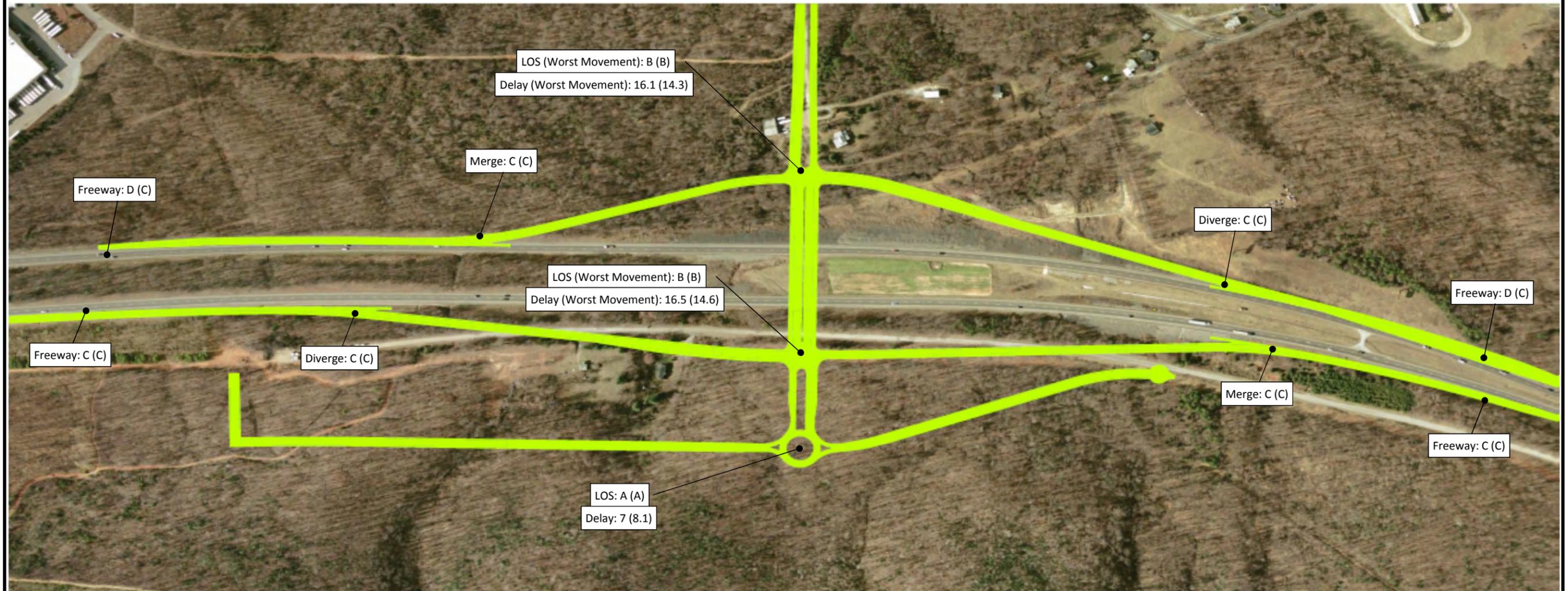


Figure 7-5
 2035 Build Design Year AM (PM) Level of Service
 Sheet 2 of 5



Figure 7-5
 2035 Build Design Year AM (PM) Level of Service
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Figure 7-5
2035 Build Design Year AM (PM) Level of Service
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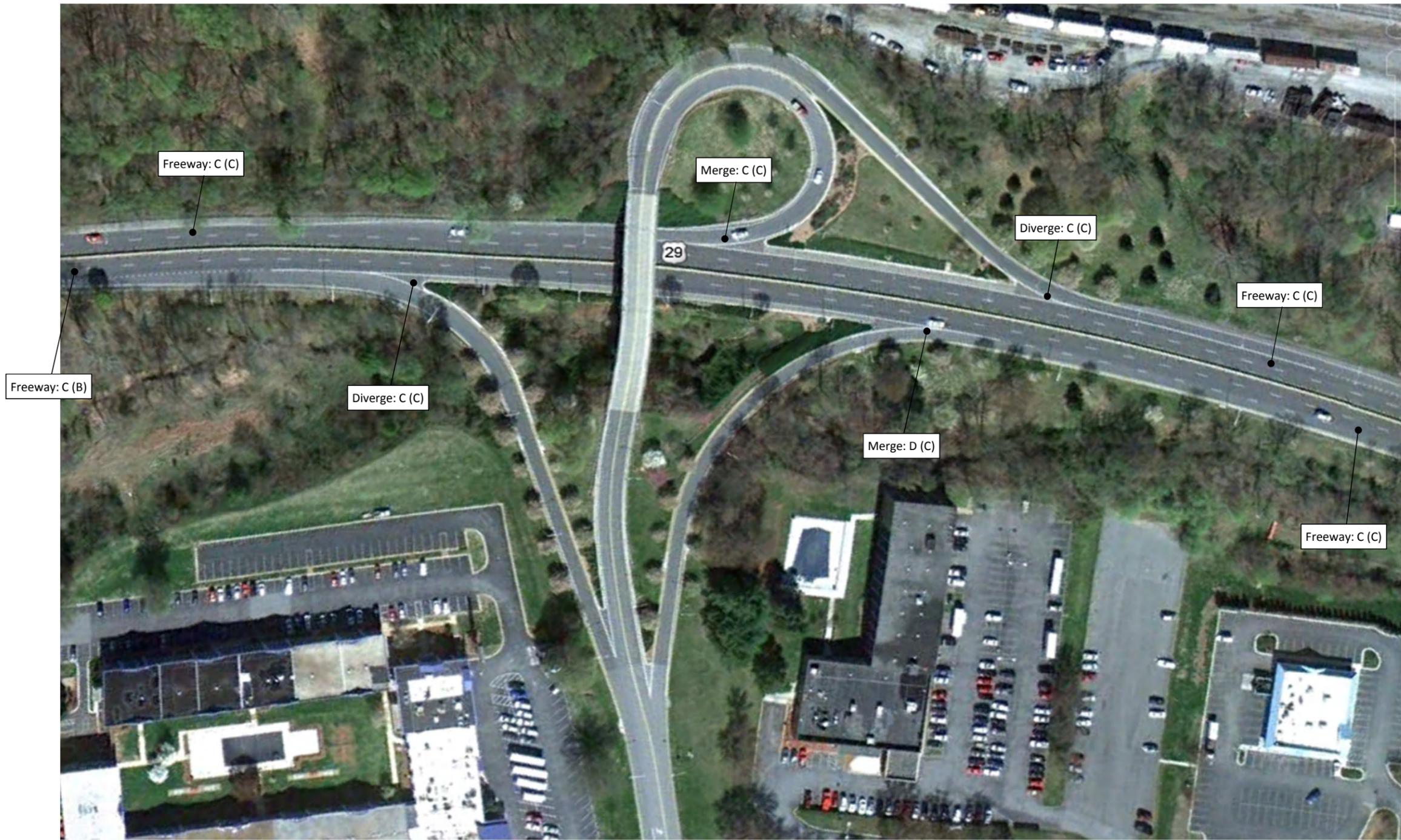


Figure 7-5
 2035 Build Design Year AM (PM) Level of Service
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Table 7-26. 2035 Build Intersection Operations

Intersection	Movement	AM			PM		
		Delay (sec/veh)	Maximum Queue (ft)	LOS	Delay (sec/veh)	Maximum Queue (ft)	LOS
Candlers Mountain Road at Mayflower Drive	NB Left	223.4	325	F	37.5	280	D
	NB Thru	21.2	520	C	26.2	525	C
	NB Right	6.3	360	A	8.5	405	A
	SB Left	144.5	685	F	57.4	690	E
	SB Thru	186.0	635*	F	83.2	635*	F
	SB Right						
	WB Left	192.5	870	F	167.5	875	F
	WB Thru						
	WB Right	48.5	280	D	53.4	280	D
ALL	109.5	-	F	61.0	-	E	
Odd Fellows Road at Mayflower Drive	EB Left	155.6	150	F	105.1	150	F
	EB Thru	43.6	690	D	43.2	500	D
	EB Right						
	WB Left	67.2	60	E	73.4	65	E
	WB Thru	63.1	80	E	70.6	70	E
	WB Right						
	NB Left	45.4	150	D	44.6	150	D
	NB Thru	150.9	675	F	106.5	630	F
	NB Right						
	SB Left	114.0	570	F	80.5	575	F
	SB Thru						
SB Right							
ALL	119.2	-	F	86.2	-	F	
Campbell Avenue at Route 460 Eastbound Off-Ramp	EB Left	207.8	915	F	371.1	520	F
	EB Right						
	NB Thru	Free-Flow			Free-Flow		
	SB Thru	Free-Flow			Free-Flow		
	ALL	-	-	-	-	-	-
Campbell Avenue at Route 460 Westbound Ramp Terminals	WB Left	32.6	140	C	69.7	275	E
	WB Right	59.6	-	E	50.8	-	D
	NB Left	19.1	185	B	34.0	160	C
	NB Thru	10.7	105	B	4.2	80	A
	SB Thru	30.7	150	C	20.8	410	C
	SB Right						
	ALL	27.7	-	C	25.0	-	C

*Queue exceeds available storage to upstream signalized intersection at Murray Place.

Compared with the No Build results, operations during both the AM and PM peaks at the Candlers Mountain Road and Mayflower Drive intersection are expected to improve. Though the AM peak LOS does not change, the delay is expected to improve by approximately 35 seconds per vehicle. In the PM peak, the overall intersection delay is projected decrease by approximately 60 seconds per vehicle (50% reduction) and the LOS is projected to improve from F to E.

On the other hand, the operations of the Odd Fellows Road and Mayflower Drive intersection are expected to degrade from LOS D to LOS F in both peaks. This increase in delay is associated with

additional through traffic using Odd Fellows Road to access the proposed interchange at Route 460. Section 7.4 discusses potential measures to mitigate the degradation in operations at this location under the Build condition.

Analyses were also conducted for the proposed Route 460 ramp terminal intersections along Odd Fellows Road. *SimTraffic* was used to evaluate the Level of Service, delays, and queues at the ramp terminal intersections

Table 7-27. 2035 Build – Route 460 / Odd Fellows Road Ramp Intersection Operations (*SimTraffic*)

Intersection	Movement	AM			PM		
		Delay (sec/veh)	Maximum Queue (ft)	LOS	Delay (sec/veh)	Maximum Queue (ft)	LOS
Odd Fellows Road at Eastbound Ramp Terminals	EB Left	16.5	195	B	14.6	145	B
	EB Right	4.7	75	A	6.0	135	A
	NB Thru	-	-	-	-	-	-
	NB Right	-	-	-	-	-	-
	SB Left	3.2	55	A	3.6	75	A
	SB Thru	-	-	-	-	-	-
	ALL	-	-	-	-	-	-
Odd Fellows Road at Westbound Ramp Terminals	WB Left	16.1	180	B	14.3	160	B
	WB Right	6.2	115	A	3.9	75	A
	NB Left	2.9	55	A	3.4	65	A
	NB Thru	-	-	-	-	-	-
	SB Thru	-	-	-	-	-	-
	SB Right	-	-	-	-	-	-
	ALL	-	-	-	-	-	-

The results in Table 7-27 indicate that the proposed ramp terminals for the Route 460 / Odd Fellows Road interchange are projected to operate acceptably during both peak hours in the Design Year (2035). Each movement would operate at LOS B or better which would satisfy the FHWA Level of Service Design Criteria for the National Highway System.

The proposed storage for the left-turns along the off-ramps is 350 feet on both the eastbound and westbound ramps; therefore, the maximum queues, which range from approximately 150 to 200 feet, would be contained within the proposed storage along the off-ramp. This indicates that during day-to-day operations, queues along the off-ramps at the proposed interchange would not back onto the Route 460 mainline, which would be an operational and safety concern. Table 7-28 provides a detailed comparison of the projected queues to the proposed storage length along the proposed new Route 460 off-ramps.

Table 7-28. 2035 Build – Route 460 / Odd Fellows Road Ramp Intersection Queues versus Proposed Storage

Intersection	Proposed Storage (ft)	AM		PM	
		Maximum Queue (ft)*	Excess/Deficiency (ft)	Maximum Queue (ft)*	Excess/Deficiency (ft)
Odd Fellows Road at Eastbound Ramp Terminals	350	195	155	145	205
Odd Fellows Road at Westbound Ramp Terminals	350	180	170	160	190

*Maximum Queues are reported from SimTraffic

Analyses for the 2035 Design Year were also conducted (*using SIDRA*) for the proposed single-lane roundabout at Odd Fellows Road and the future Top Ridge Road Connector. The roundabout will be constructed as part of this project, but the future connector roads will be constructed by others (potentially in sequence with the interchange improvements). This analysis was used to verify that the proposed 360-foot spacing between the eastbound Route 460 ramp terminal intersection and the proposed roundabout would be sufficient to ensure that the roundabout does not impact the operations of the interchange. The analysis indicates that the proposed roundabout would operate at LOS A in both the AM and PM peak hours. The queues along the southbound Odd Fellows Road approach would be less than 50 feet during the AM peak hour and 70 feet during the PM peak hour. These queues are substantially less than the available 360 feet of spacing between intersections and indicate that the proposed roundabout would not impact operations of the interchange in the Design Year.

Table 7-29. 2035 Build – Odd Fellows Road / Future Top Ridge Road Connector Roundabout Operations

	AM			PM		
	Delay (sec)	LOS	95 th -Percentile Queue (ft)	Delay (sec)	LOS	95 th -Percentile Queue (ft)
EB Top Ridge Rd	7.0	A	35	8.2	A	45
WB Top Ridge Rd	6.0	A	15	7.1	A	20
SB Odd Fellows Road	7.3	A	50	8.5	A	70
ALL	7.0	A	-	8.1	A	-

Summary: In the Design Year (2035), all components of the proposed new interchange at Route 460 and Odd Fellows Road is projected to operate acceptably (in terms of FHWA’s Level of Service Design Criteria).. The proposed ramp junctions along Route 460 would operate at LOS C or better in both peak hours; additionally, the proposed ramp terminal intersections along Odd Fellows Road would operate at LOS B or better, with minimal queuing along the eastbound and westbound Route 460 off-ramps. Additionally, due to changes in traffic patterns within the Study Area, operations at the Candler Mountain Road / Mayflower Drive intersection are projected to improve from the No Build condition.

These results indicate that the proposed interchange would function efficiently and help address the operational, access, and system connectivity needs identified in Chapter 1.

7.4. Odd Fellows Road / Mayflower Drive Mitigation

At this time, VDOT is still coordinating with the City of Lynchburg regarding the potential improvements at the Odd Fellows Road / Mayflower Drive intersection to mitigate the deficiencies in the Opening Year and Design Year operations projected to result from additional traffic using the Odd Fellows Road corridor to access the proposed new interchange at Route 460. Two options are currently under further evaluation:

1. Convert the existing signalized intersection to a single-lane roundabout.
2. Modify the southbound Odd Fellows Road approach to provide separate left-turn and right-turn lanes; and modify the north-south phasing along Odd Fellows Road from split phasing to concurrent phasing.

Both potential improvements were evaluated using the projected Design Year 2035 Build traffic volumes. The results for each improvement option are compared to a baseline “no improvement” scenario at the intersection in Table 7-30. The results are HCM Levels of Service and Delay.

Table 7-30. 2035 Build –Odd Fellows Road / Mayflower Drive Ramp Intersection Operations Mitigation Alternatives

Movement	AM						PM					
	Baseline		Improved Signal		Roundabout		Baseline		Improved Signal		Roundabout	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
EB Left	155.6	F	15.8	B	19.7	B	105.1	F	23.1	C	12.9	B
EB Thru	43.6	D	12.3	B			43.2	D	17.4	B		
EB Right												
WB Left	67.2	E	29.9	C	11.4	B	73.4	E	37.1	D	9.8	A
WB Thru	63.1	E	29.5	C			70.6	E	36.8	D		
WB Right												
NB Left	45.4	D	27.3	C	29.4	C	44.6	D	12.5	B	13.9	B
NB Thru	150.9	F	13.8	B			106.5	F	11.8	B		
NB Right												
SB Left	114.0	F	9.6	A	14.3	B	80.5	F	16.1	B	16.4	B
SB Thru			16.6	B					27.6	C		
SB Right			10.5	B					17.1	B		
ALL	119.2	F	15.7	B	20.1	C	86.2	F	19.5	B	14.8	B

The results in Table 7-30 indicate that either improvement option would result in LOS C or better operations overall at the intersection of Odd Fellows Road and Mayflower Drive. The roundabout option would provide slightly better operations for certain movements compared to the improved signal option; similarly, certain movements would operate better under the option to improve the signal with additional turn lanes.

Additional survey is currently being obtained and conceptual layouts will likely be developed for both options to enable a more informed decision to be made regarding the cost of impacts of the two options. For the purposes of this IJR, it is assumed that one of these two improvements will ultimately be implemented to address the future deficiencies identified at this intersection.

7.5. Crash Data and Analysis

A review of recent crash data within the Study Area was conducted and the results are summarized in Section 3.8 of this IJR. The safety analysis was conducted for the three-year period between November 1, 2008 and October 31, 2011 along Candler's Mountain Road, Mayflower Drive, and Odd Fellows Road and between January 1, 2007 and December 31, 2008 for Route 460. The analysis identified the number, type, and severity of crashes within the Study Area. A quantitative analysis was used to identify critical crash locations along the study corridor and major contributing factors. After the Preferred Build Alternative was identified, a qualitative assessment of the future safety performance of the Study Area, including the proposed Route 460 / Odd Fellows Road interchange, was conducted to determine any safety-related impacts of the proposed roadway improvements. Additionally, per IIM 200.5, the Highway Safety Manual should be used when applicable to assess the quantitative safety impacts of proposed modifications. However, the freeway module for the Highway Safety Manual had not been publicly released at the time this IJR was completed. Therefore, FHWA's *Surrogate Safety Assessment Model (SSAM)* was utilized as applicable based on the *VISSIM*-modeled vehicle trajectories to quantify the potential safety impacts of the proposed modifications.

A brief summary of the results of the existing crash analysis are as follows. Additional detail can be found in Section 3.8:

- A total of 15 crashes were reported along Route 460 in 2007 and 2008.
- A total of 256 crashes were reported along Candler's Mountain Road from November 2008 to October 2011.
- A total of 15 crashes were reported along Odd Fellows Road from November 2008 to October 2011.
- Along Route 460, rear-end crashes (40 percent) were the predominant crash type. Other common crash types included fixed object crashes (33 percent) and other crashes (20 percent).
- Along Candler's Mountain Road, rear-end crashes (59 percent) were the predominant crash type. Other common crash types included angle crashes (31 percent) and sideswipe crashes (6 percent).
- Along Odd Fellows Road, angle crashes (60 percent) were the predominant crash type. Other common crash types included rear-end crashes (27 percent) and "Other" (animal, etc) crashes (13 percent).
- One (1) fatal crash was reported along Odd Fellows Road.
- Of all crashes evaluated, approximately 83 percent of crashes were reported on dry pavement surfaces.
- Of all crashes evaluated, approximately 75 percent of crashes occurred during daylight and 25 percent occurred under dark conditions.

7.5.1. No Build Crash Analysis

The Route 460 / Odd Fellows Road IJR Study Area is located within the City of Lynchburg. Route 460 near the proposed interchange has some slight horizontal curvature and a relatively flat grade. Nearby interchanges include Candler's Mountain Road where a directional "T" style interchange is in place, and Campbell Avenue where a partial-cloverleaf interchange is utilized.

The median along Route 460 in the Study Area is wide and depressed with a median ditch. The land adjacent to Route 460 on the north is developed and mostly industrial in use. To the south, the land is wooded, and because of the proximity of Candler's Mountain, the terrain is steep. The wooded nature of the land south of Route 460 may lead to wildlife crossing the roadway but the historical data did not lead to any particular indication of a trend of frequent crashes involving wildlife.

If the interchange at Odd Fellows Road is not constructed, it is reasonable to assume that the existing crash patterns would continue into the future. As future congestion increased, the number of crashes would be expected to increase, but the general location of crashes and crash rates would be expected to be similar to the existing conditions.

7.5.2. Future Build Crash Analysis

As noted in Chapter 1, one purpose of the proposed interchange at Route 460 and Odd Fellows Road is to accommodate existing future traffic demand in the Study Area by reducing the volume of traffic along Candler's Mountain Road; reducing congestion along this corridor may also help reduce collisions associated with that congestion. The study segment of Candler's Mountain Road has a high crash rate, nearly 700 percent above the statewide average for similar facilities as noted in Section 3.8.2, with the predominant crash type being rear end collisions. This collision type is common at signalized intersections under congested conditions due to the "stop-and-start" nature of the traffic flow, quick speed changes, and closely spaced vehicles. Shifting traffic away from this intersection would reduce the overall number of potential conflicts and may be expected to reduce the overall occurrence of crashes.

The expected impacts of the proposed improvements at the study locations are as follows:

- The proposed interchange at Route 460 and Odd Fellows Road is expected to create a shift in traffic patterns for vehicles attempting to access the industrial district along Odd Fellows Road and Mayflower Drive. This would be expected to shift traffic from Candler's Mountain Road and reduce the potential for all collisions but notably for **rear-end** collisions. Nearly 60 percent of the collisions noted along Candler's Mountain Road currently are **rear-end** crashes and with less traffic at the signalized intersections queues would be expected to be reduced which may reduce the frequency of rear-end crashes.
- Reducing the total volume of traffic using the ramps at the Candler's Mountain Road and Campbell Avenue interchanges may not necessarily reduce the total number of crashes within the Study Area but it would be expected to distribute them differently, with crashes along the ramps at both these existing interchanges expected to decrease. Particularly at the Route 460 / Campbell Avenue interchange, the interchange geometry leads to lower speeds along the ramps which may result in greater speed differentials along the mainline. These speed differentials may contribute to **rear-end**, **sideswipe**, and **fixed object collisions**. By reducing the volume of

traffic utilizing the existing ramps at these interchanges, the proposed Build Alternative would be expected to reduce crashes.

Quantitative Analysis: The *Surrogate Safety Assessment Model (SSAM)* was reviewed to determine if the potential safety impacts of the proposed improvements could be quantified. *SSAM* utilizes trajectory files from *VISSIM* (which contain the model geometry and the vehicle speed and location data for the vehicles modeled during the simulation). This data is evaluated in the *SSAM* software and a total number of potential conflicts are estimated within the simulated network. *SSAM* was validated as a reasonable method for assessing traffic safety impacts by FHWA in publication [FHWA-HRT-08-051](#). An expected number of crashes per year for different scenarios can be estimated by a mathematical relationship between the number of potential conflicts (from the trajectory files) and the number of crashes. As noted in the report, that relationship is described as:

$$\frac{Crashes}{Year} = 0.119 \times \left(\frac{Conflicts}{Hour} \right)^{1.419}$$

The conflict data is extracted from the *SSAM* output and run through that mathematical model to develop the expected number of annual crashes. For the purposes of this study, both the AM and PM peak hour models were utilized and the yearly crash rates were then computed as the average of the results for the two peak hours. For this IJR, the intent of the *SSAM* analysis is to evaluate the **relative** differences between the expected number of crashes for the No Build and Build Alternatives. In other words, the raw number of expected crashes is less important than the relative differences between alternatives.

This effort was conducted for the Design Year for the No Build and Build Alternatives. The data is summarized for the existing interchange ramp junctions and intersections in Tables 7-31 and 7-32.

Table 7-31. Interchange Ramps, SSAM Expected Crash Frequency

Ramp	Design Year (2035) No Build	Design Year (2035) Build
Route 460 Eastbound Candler Mountain Off-Ramp	6.35/year	1.42/year
Route 460 Eastbound Candler Mountain On-Ramp	0.28/year	0.00/year
Route 460 Westbound Candler Mountain Off-Ramp	4.18/year	1.72/year
Route 460 Westbound Candler Mountain On-Ramp	0.06/year	0.06/year
Route 460 Eastbound Campbell Off-Ramp	0.44/year	3.81/year
Route 460 Eastbound Southbound Campbell On-Ramp	0.76/year	0.28/year
Route 460 Eastbound Northbound Campbell On-Ramp	0.06/year	0.06/year
Route 460 Westbound Campbell Off-Ramp	0.06/year	2.02/year
Route 460 Westbound Campbell On-Ramp	2.29/year	3.47/year
Business Route 29 Northbound Odd Fellows Off-Ramp	0.58/year	2.02/year
Business Route 29 Northbound Odd Fellows On-Ramp	0.43/year	0.06/year
Business Route 29 Southbound Odd Fellows Off-Ramp	0.00/year	0.22/year
Business Route 29 Southbound Odd Fellows On-Ramp	1.22/year	1.01/year
Total (ALL Ramp Crashes)	16.22/year	16.15/year

Table 7-32. Route 460 / Odd Fellows Road Study Area Intersections, SSAM Expected Crash Frequency

Ramp	Design Year (2035) No Build	Design Year (2035) Build
Candlers Mountain Road at Mayflower Drive	320.55/year	220.62/year
Mayflower Drive at Odd Fellows Road (No Improvement)	26.38/year	85.51/year*
Campbell Avenue at Route 460 Westbound Ramps	24.42/year	15.64/year
Campbell Avenue at Route 460 Eastbound Ramps	5.23/year	4.18/year
Total (ALL Intersection Crashes)	376.57/year	325.95/year

*Results reflect the operations of the unimproved intersection. Once a specific improvement option is identified, the results will be updated to reflect the improved configuration.

The results in Table 7-31 indicate that constructing the interchange at Route 460 and Odd Fellows Road will generally have a small impact on the safety performance of the existing ramp junctions along the Route 460 corridor. Due to the changing traffic patterns within the Study Area, the number of crashes expected at certain ramp junctions will decrease and the number of crashes anticipated at other locations will increase; the net effect is a slight decrease in the projected crashes at the adjacent interchanges.

For the existing intersections in the Study Area, the SSAM analysis results in Table 7-32 indicate that the proposed Build Alternative would result in a reduction of approximately 13 percent in the number of expected annual crashes in the Design Year. Specifically at the Candlers Mountain Road / Mayflower Drive intersection, the projected reduction in annual crashes is approximately 31 percent. It should be noted that this initial safety analysis assumed no improvements to the congested Mayflower Drive / Odd Fellows Road intersection; improvements at that location (see Section 7.4) would be expected to improve the safety performance at that location as well, which would increase the overall safety benefits of the Build Alternative.

SSAM does not provide severity information regarding the collisions, but given the relatively high (82 percent) percentage of property-damage only crashes noted in the historical crash data, it is likely that a similar severity profile would occur with these collisions.

8. LAND USE

This request for new access along Route 460 via an interchange at the proposed extension of Odd Fellows Road is not associated with a specific proposal for new development in the Study Area. The proposed addition of this interchange is primarily meant to address safety and operational concerns along adjacent facilities, notably Candler's Mountain Road, improve access (particularly for truck traffic) between Route 460 and the industrial facilities in and around the First Lynchburg Industrial Park located along Odd Fellows Road / Mayflower Drive, and improve overall system connectivity within the City of Lynchburg. These access and system linkage improvements may also encourage future economic development within the Study Area. It should be noted that the City and Liberty University do have future plans to develop the unused land around the proposed interchange. A brief summary of the existing land use and future planned development within the Study Area is provided below. Additional information on the land use in the Study Area can be found in Chapters 3 and 6.

8.1. Local Land Use and Status

To the south of Route 460, the land uses in the Study Area are currently zoned R-2 (Low-Medium Density Single-Family Residential) and R-C (Resource Conservation). Most of this area is located on the northern slope of Candler's Mountain and is currently unused land. To the north of Route 460, almost all of the land uses are zoned and operating I-2 (Light Industrial) and I-3 (Heavy Industrial). These land uses are part of an industrial area including the First Lynchburg Industrial Park. There are numerous warehouse, distribution, and other facilities located within the industrial area which generates substantial numbers of truck trips which utilize the local road system (Odd Fellows Road, Mayflower Drive, and Candler's Mountain Rd) to access major regional freeway facilities including Route 460 and the Lynchburg Expressway (Route 29 Business).

8.2. Future Planned Development

For the area north of Route 460 (bounded to the west by Candler's Mountain Road, to the north by the Lynchburg Expressway, and the Norfolk Southern railroad), the City of Lynchburg's current planning documents envision continued use as an manufacturing / distribution employment area. There are numerous vacant parcels within the First Lynchburg Industrial Park, and adjacently zoned industrial areas, which have the potential for development in this zone, but no specific developments are currently proposed. The City's planning documents also identify a potential mixed-use development, centered on the Odd Fellows Road / Murray Place intersection. This mixed-use development would integrate existing uses including the Genworth Financial complex and the Liberty University Residential Annex currently located in this area.

Most of the property to the south of Route 460 within the Study Area is owned by Liberty University, which envisions future development in that area. Liberty University has developed a preliminary Master Plan for the area south of Route 460, which identifies potential future uses for the area abutting the proposed Route 460 / Odd Fellows Road interchange. These potential uses are primarily service-oriented, and include:

- 150-room Hotel
- High-Turnover Sit-Down Restaurant
- Fast Food Restaurant with Drive-Thru Window
- Shopping (up to 26,500 GSF)
- Gasoline and Service Station with Market

Combined, these uses are projected to generate approximately 790 trips in the AM peak hour and 880 trips in the PM peak at full build out in the Design Year. Primary access to these uses would occur via the proposed Route 460 / Odd Fellows Road interchange.

While a specific development is not the primary reason for the proposed construction of a new grade-separated interchange at Route 460 and Odd Fellows Road, sufficient coordination has occurred to ensure that the future development potential of the Study Area has been appropriately considered in this analysis. As detailed in Chapter 6, additional traffic expected to be generated by future development within the Study Area has been included in the future year traffic volume forecasts. This development was accounted for through the future demographic projections in the regional model and trip generation for potential development within the Liberty University expansion area. As detailed in Chapter 7, capacity analyses were conducted to determine that the proposed roadway network configuration could accommodate the future traffic volumes which include additional traffic anticipated to be generated by new development within the Study Area.

9. ENVIRONMENTAL COMPLIANCE

The required National Environmental Policy Act (NEPA) document for this project is an Environmental Assessment (EA). The document will assess the potential for significant impacts to the human or natural environment. The following areas are expected to be reviewed for potential significant impacts:

- Socio-Economic
- Section 4(f) and Section 6(f)
- Cultural Resources
- Natural Resources
- Agricultural / Open Space
- Farmland
- Invasive Species
- Air Quality
- Noise
- Right-of-Way and Relocations
- Cumulative and Indirect impacts
- Public Involvement
- Coordination

VDOT is scheduled to complete the draft EA and hold a public hearing in January 2013. The final EA is expected to be completed in April 2013 and a Finding of No Significant Impact (FONSI) is anticipated to be issued in June 2013.

As this project is non-Interstate and the construction budget does not exceed \$25 million, FHWA approval of the proposed change in access along Route 460 is not required. VDOT, however, does recognize that final design and construction of the proposed interchange cannot proceed until the NEPA process has concluded. The intent of this report is to obtain VDOT approval that the engineering and operations of the proposed Build Alternative are acceptable.

A. IJR SCOPING DOCUMENT

UPC #100023

Route 460 and Odd Fellows Road Extended Interchange Justification Report (IJR)

Scoping Document for VDOT / FHWA

November 14, 2011 (Revised December 8, 2011)

In accordance with the latest Interstate and Non-Interstate Systems (IJR/IMR) Instructional and Informational Memorandum (IIM-LD-200.4), this scoping document has been developed for review by VDOT and FHWA.

Project Description: This project is for the design of the extension of Odd Fellows Road and a new interchange along Route 460 in Lynchburg, VA. The proposed interchange will require new ramps, new acceleration / deceleration lanes along Route 460, and a new structure over Route 460. Multiple interchange alternatives will be considered prior to identifying a preferred configuration.

1. Assumptions Used in IJR

Critical assumptions to be used in developing the IJR for the proposed new interchange are summarized in the following sections.

2. Existing and Proposed Geometrics

Existing: The existing Route 460 corridor in the study area consists of two mainline lanes per direction. There are existing interchanges along Route 460 at Candler's Mountain Road (0.8 miles to the west) and at Campbell Avenue (0.8 miles to the east). Odd Fellows Road is currently a two-lane road, which terminates north of Route 460.

Proposed: The proposed improvements would construct a new interchange along Route 460 at Odd Fellows Road between the two existing interchanges at Candler's Mountain Road and Campbell Avenue. It is assumed that Route 460 will remain two mainline lanes per direction, but the need for auxiliary lanes between the adjacent interchanges will be evaluated during the study. Odd Fellows Road will be extended from its current terminus, across Route 460 on structure, and connected to Top Ridge Road. Additional improvements at the Odd Fellows Road / Mayflower Drive intersection to accommodate increased traffic volumes on Odd Fellows Road will also be evaluated.

3. Proposed Traffic Analysis Tools and Approach

Operational Analysis:

Traffic operations analyses will be performed for existing conditions using the Highway Capacity Manual and HCS software, latest version (and/or Synchro model), and a traffic simulation using VISSIM will be developed to provide an additional analysis of the proposed interchange and surrounding network. If alternatives with roundabouts are considered, then SIDRA Version 5 will be used to evaluate roundabout operations. Traffic operations analysis will be conducted for the No Build Alternative and

up to five potential build alternatives for the US 460/Odd Fellows Road interchange for both Opening Year and Design Year conditions using the Highway Capacity Manual and HCS software. These analyses will take into account all necessary elements of the system to accurately portray the traffic operations of the network. These elements include intersections, ramp junctions (merges and diverges), weaving segments, and freeway segments.

As part of the simulation analysis, the model will be calibrated with real traffic conditions as observed in the field and run a minimum of ten times for one full hour, with the average of ten (10) runs reported. All calibration adjustments will be documented in the report. The calibrated model will be used as a base to compare the future year scenarios.

Traffic counts will also be considered in designing the new interchange. Daily link counts will be collected on the mainline (Route 460), on the ramps at the two adjacent Route 460 interchanges (at Candler Mountain Road and at Campbell Avenue), on the ramps at the Route 29 Business / Odd Fellows Road interchange, and on Odd Fellows Road. Additionally, peak hour turning movement counts will be collected at four (4) at-grade intersections within the study area.

Traffic line diagrams will be prepared for the study network, with each lane represented by a line on the diagram. Existing ADTs, AM and PM peak hour volumes, and truck percentages will be posted on the diagram. Traffic MOE's (levels of service, speed, delays, and queues in feet) will also be posted, for a complete summary graphic of existing conditions along Route 460.

Safety Analysis:

As part of the investigation of existing traffic conditions, a review of the three-year crash history along Route 460, from west of US 29 to east of US 501, will be conducted for inclusion in the analysis of the interchange and main line improvements as part of the IJR. Crash data will also be evaluated for Candler Mountain Road, Campbell Avenue, and Odd Fellows Road.

4. Study Area

The proposed improvements cover a distance of approximately one mile along Route 460 and approximately one-quarter mile along existing Odd Fellows Road and include a new bridge over Route 460. The study area to be analyzed for the IJR will include mainline Route 460 from the Candler Mountain interchange to the west and the Campbell Avenue interchange to the east. Odd Fellows Road will be analyzed from the proposed Route 460 interchange to its existing interchange with Route 29 Business to the north, including the signalized intersection at Mayflower Drive. Candler Mountain Road will be analyzed from Route 29 Business to Route 460.

5. Peak Periods for Analysis

Two peak periods will be evaluated for this study. It is assumed that the weekday AM and PM peak periods will be used for these capacity analyses.

6. Traffic and Crash Data

Updated traffic counts will be obtained, as described in Item 3 above. Crash data for the most recent three-year period available will be obtained from VDOT and/or the City of Lynchburg.

7. Design Year

The Design Year typically utilized for an IJR would be the anticipated Advertisement Date + 22 Years. Based on the current project schedule, advertisement would be in 2013 and the Design Year would be 2035.

8. Opening Year

Opening Year conditions will be analyzed for this study. The projected Opening Year is assumed to be 2016 (advertisement + 3 years).

9. Travel Demand Forecasts

Future traffic forecasts for this study will be obtained based on output from the Lynchburg Area Travel Demand Model. The most recent version of the horizon year (2035) transportation network files will be examined to verify that the network includes all projects in the financially-constrained long-range plan (CLRP) scheduled for completion by 2035. Any discrepancies will be noted and corrected prior to running the model. The future land use projections will also be reviewed to verify that the land use matches the latest approved projections from the MPO. Additionally, coordination will occur between VDOT and the City of Lynchburg and their land use consultants to assess potential alternative land use scenarios to be used in sensitivity analyses of the interchange operations. The Traffic Analysis Zones (TAZs) adjacent to the proposed interchange will be closely examined to verify that the potential future development is reflected in the model. It may be necessary to split TAZs in this area and otherwise modify the land use assumptions.

The model will be run for two (2) scenarios: Base Year (2007 is the Base Year assumed in the model) and Horizon Year (2035). The base year model run results will not be used for operational analysis, but are required to run and calibrate the horizon year model. In the Horizon Year, two Alternatives will be considered: No Build (Odd Fellows Road / Route 460 interchange not constructed) and Build (Odd Fellows Road / Route 460 interchange is constructed).

The travel demand model output will be refined or calibrated using the existing (2011) traffic volume data following the procedures in Chapter 4 of NCHRP Report 255: Highway Traffic Data for Urbanized Area Project Planning and Design. Opening Year (2016) and Design Year (2035 – assume 2013 ad-date + 22 years = 2035) Average Daily Traffic volumes will be developed. To develop Opening Year forecasts for the Build Alternative, the 2007 Base Model network will be modified to include the proposed interchange. Growth rates will then be determined between the Base Year (2007) and Horizon Year (2035) and those growth rates will be used to interpolate Opening Year 2016 volumes. VDOT will provide available permanent count station data along the Route 460 corridor to identify K-factors which can be applied to the ADTs to generate the peak hour link and turning movement volumes for this

analysis. It is the intent to select a K-factor which would equate to 30th-highest hour conditions, typically referred to as Design Hourly Volumes. One set of “design hour” forecasts will be developed using this K-factor and then existing directional patterns will be used to develop separate AM and PM peak hour forecasts.

For purposes of comparison to the regional model output, a review of historical traffic data along the Route 460 corridor will be conducted to determine the historical rate of traffic growth for both automobiles and trucks. These annual growth rates will be applied to the updated traffic counts collected for this study and the future year forecasts for Route 460 projected using the regional model.

A technical memorandum will be developed summarizing the travel demand forecasting procedures and Opening Year and Design Year forecasts and submitted to VDOT for review prior to initiating the detailed analysis of future conditions.

10. Baseline Conditions

The Baseline (Existing) conditions will include the existing interchanges along Route 460, the existing configuration (two mainline lanes per direction) along Route 460, and the existing terminus of Odd Fellows Road, north of Route 460.

11. Design Year Conditions

Two alternatives will be considered: No Build (Odd Fellows Road / Route 460 interchange not constructed) and Build (Odd Fellows Road / Route 460 interchange is constructed).

- No Build: The Opening Year and Design Year No Build conditions will include the existing interchanges along Route 460 and the existing configuration (two mainline lanes per direction) along Route 460.
- Build: Opening Year and Design Year conditions for this Build Alternative will include the extension of Odd Fellows Road and the proposed interchange on Route 460. As noted above, up to five interchange configurations will be evaluated for the Build conditions. The results of the operational analysis for these configurations will be provided to VDOT for review and considered during the selection of the preferred configuration. The IJR documentation will focus on the preferred configuration, but analysis results for other options considered will be included as appropriate in the IJR and attached as an Appendix.

12. Policy Points to be Utilized and Level of Detail for Each One

All eight of the FWHA Policy Points will be addressed by this proposal for revised access to a limited access highway. The level of detail needed to address each policy point will vary substantially. The following is a summary of the level of detail expected to address each of the policy points:

- Point 1: Need for Revised Access – Level of Detail – High: The proposal is a new interchange; therefore, sufficient information will be provided to detail as why the existing transportation system cannot accommodate the design year traffic demands.

- Point 2: Reasonable Alternatives – Level of Detail – Medium: A number of interchange alternatives will be considered at this location before selecting a preferred configuration. A decision matrix will be included detailing the specific criteria used to select the preferred configuration. These criteria are anticipated to include, but not be limited to, traffic operations, cost, right-of-way impacts, and environmental factors. These alternatives will be documented in the IJR. TSM alternatives will also be considered as appropriate.
- Point 3: Operational and Collision Analyses – Level of Detail – High: Operational and safety analyses will be conducted in accordance with this scoping document. The design will be intended to provide safe and efficient operations at the study interchange and accommodate future improvements to the Route 460 / Odd Fellows Road corridors as needed.
- Point 4: Access Connections and Design – Level of Detail – Medium: Access is to a public road and would provide full movements to and from Route 460. While the modifications are expected to meet or exceed current standards, any potential design exceptions and/or waivers will be identified.
- Point 5: Land Use and Transportation Plans – Level of Detail – Low: Local land use and transportation plans will be reviewed to verify that the proposed interchange is consistent with those plans.
- Point 6: Future Interchanges – Level of Detail – Very Low: No future interchanges are proposed along this segment of Route 460.
- Point 7: Coordination – Level of Detail – Medium: There are large vacant parcels adjacent to the proposed Route 460 interchange which may be considered for future development. The potential future development of these sites will be considered in this evaluation, to the extent that information is available. Coordination with the local jurisdictions will be documented.
- Point 8: Environmental Processes – Level of Detail – Medium: VDOT will complete the required NEPA document for the project. A summary of the document, as well as its approval status at the time of submission, will be included in the IJR.

B. LETTER OF COMMITMENT FROM LOCALITY

C. CERTIFIED TRAFFIC DATA

Provided on enclosed CD ROM

D. TRAFFIC SOFTWARE ANALYSIS RESULTS

Provided on enclosed CD ROM

E. ENVIRONMENTAL DOCUMENT SUMMARY

NOT AVAILABLE AT THIS TIME. DOCUMENT EXPECTED TO BE COMPLETED IN EARLY-2013.

F. CONCEPTUAL SIGNING PLAN

Sign Placement and Compliance Details

Sign S-1: To be installed ½ mile in advance of the exit both to the North and South of the interchange on the right side of the roadway

Sign S-2: To be installed at the beginning to the exit/deceleration lane on both the North and South approaches on the right side of the roadway

Sign S-3: To be installed at the gore on the right side of the thru lanes and to the left of the exit ramp

Sign S-4: To be installed at the end of the ramp at the intersection of the exit ramp and Odd Fellows Road for both the exit from the North as well as the South.

Sign S-5: To be relocated downstream of the existing location past the entrance from Odd Fellows Road, approx. sta. 2236+00 NB. Sign is not in compliance with 2E.10 regarding amount and type of legend (see note 1 below). However, this section is only guidance and is not a standard. Due to relocation panel requires modification to the exit distance. Two options are shown. Option A is to relocate the signs to the specified location above and overlay the distance the 1 with ½. Option B is to remove the existing sign and install a new sign which both shows the correct distance and is MUTCD compliant.

Sign S-6: To be relocated downstream of the existing location past the entrance from Odd Fellows Road, approx. sta. 3185+50 SB. Sign is not in compliance with 2E.10 regarding amount and type of legend (see note 1 below). However, this section is only guidance and is not a standard. Due to relocation panel requires modification to the exit distance. Two options are shown. Option A is to relocate the signs to the specified location above and overlay the distance the 1 with ½. Option B is to remove the existing sign and install a new sign which both shows the correct distance and is MUTCD compliant.

Note 1:

“Section 2E.10 Amount of Legend on Guide Signs”

Guidance:

01 No more than two destination names or street names should be displayed on any Advance Guide sign or Exit Direction sign. A city name and street name on the same sign should be avoided. Where two or three signs are placed on the same supports, destinations or names should be limited to one per sign, or to a total of three in the display. Sign legends should not exceed three lines of copy, exclusive of the exit number and action or distance information.” – MUTCD

Signs S-5 and S-6 are both in violation of this guidance due to the presence of both a city name and a street name.

US-460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT

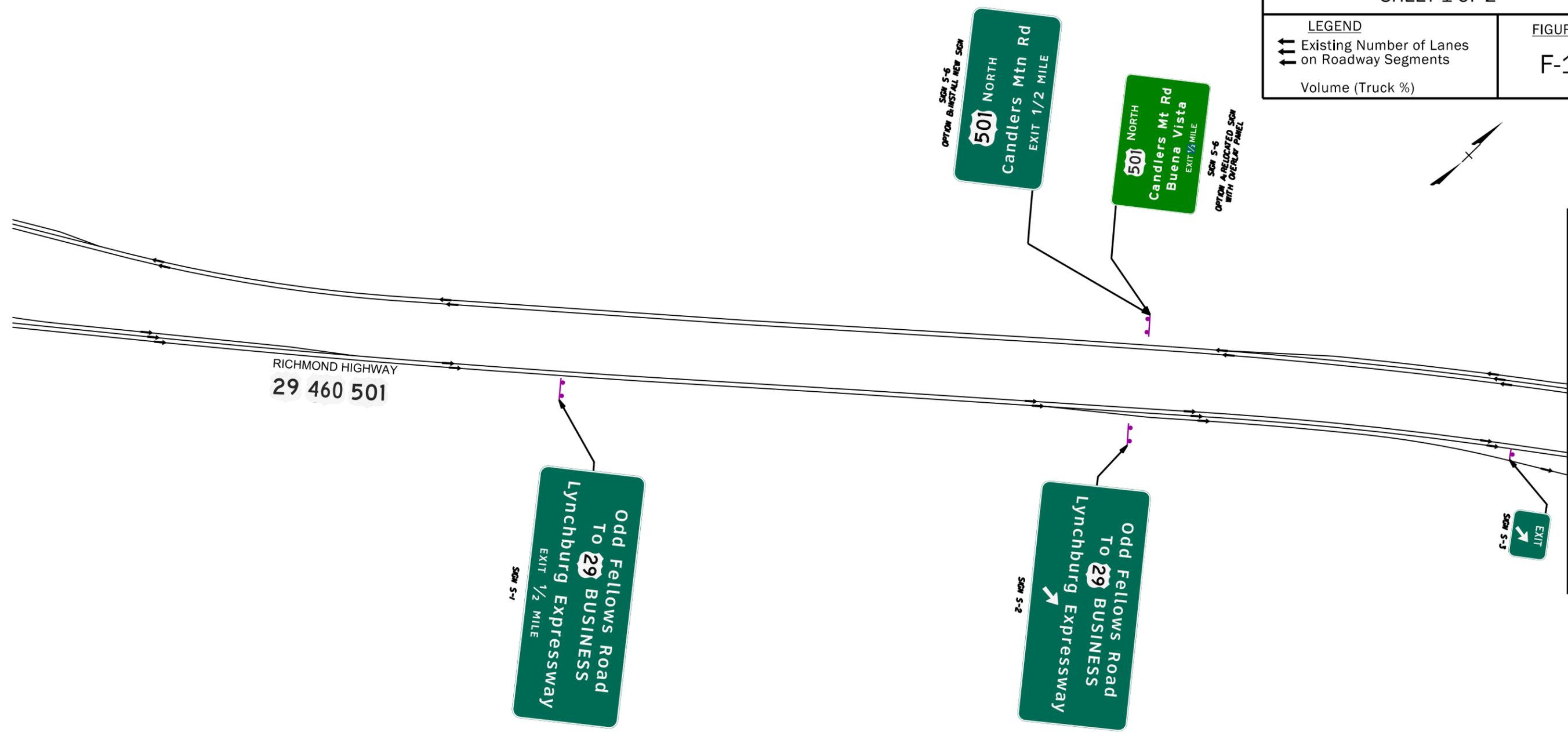


DATE:
DECEMBER 2012

CONCEPTUAL SIGNING PLAN
SHEET 1 OF 2

LEGEND	
←←	Existing Number of Lanes on Roadway Segments
←	Volume (Truck %)

FIGURE
F-1



US-460 / ODD FELLOWS ROAD INTERCHANGE JUSTIFICATION REPORT

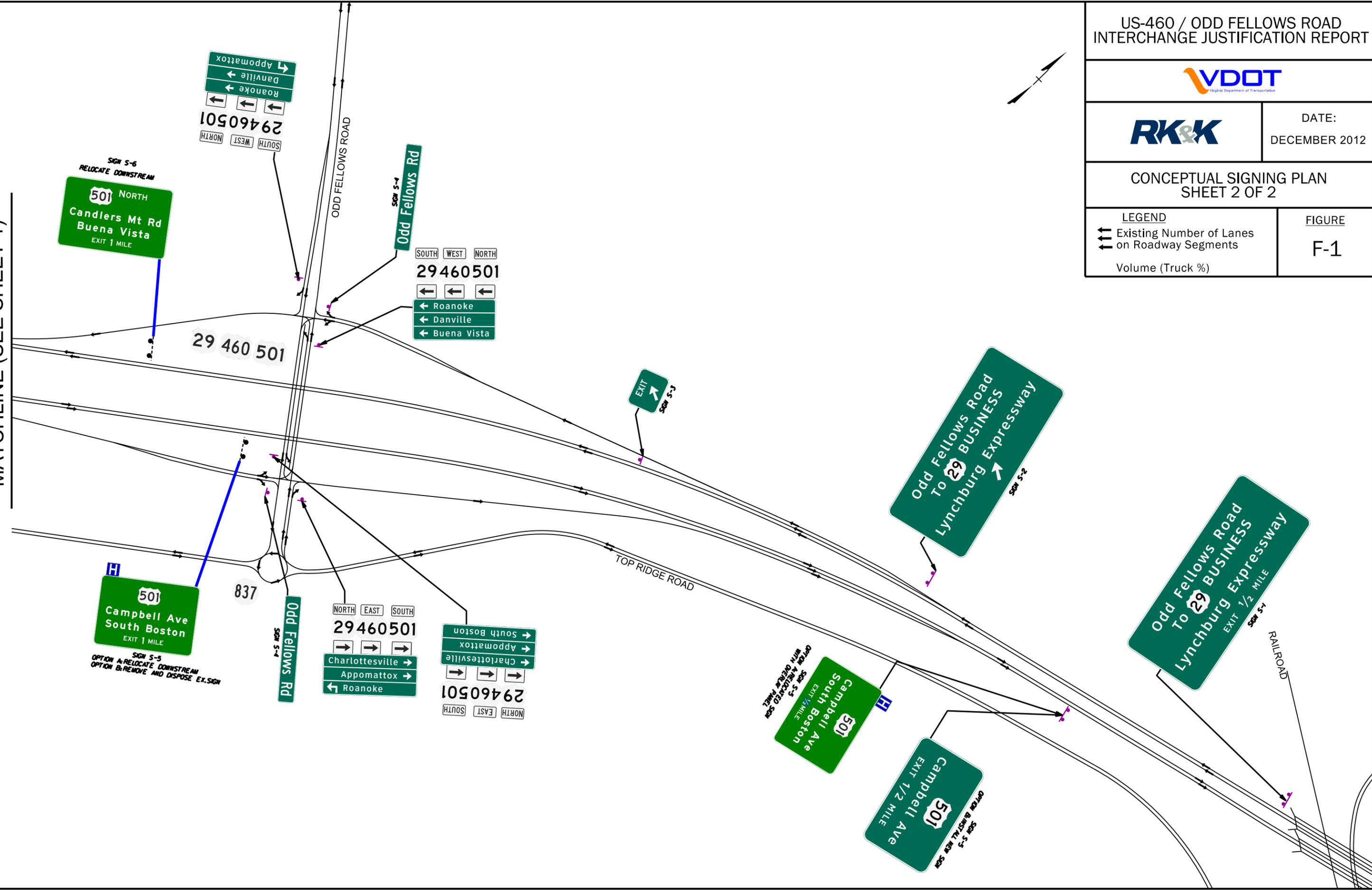


DATE:
DECEMBER 2012

CONCEPTUAL SIGNING PLAN
SHEET 2 OF 2

<p>LEGEND</p> <p>← Existing Number of Lanes on Roadway Segments</p> <p>Volume (Truck %)</p>	<p>FIGURE</p> <p>F-1</p>
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MATCHLINE (SEE SHEET 1)



G. CONCEPTUAL DESIGN AND TYPICAL SECTIONS

Provided on enclosed CD ROM

H. REQUIRED DESIGN EXCEPTIONS OR WAIVERS

Potential DEs / DWs still being reviewed by Design Team and VDOT.

I. GLOSSARY OF TERMS

The following abbreviations have been used in this report:

AASHTO	American Association of State Highway and Transportation Officials
ADMS	Archived Data Management System
ADT	Average Daily Traffic
CD	Collector-Distributor
CTB	Commonwealth Transportation Board
EA	Environmental Assessment
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
HCM	Highway Capacity Manual
HCS+	Highway Capacity Software
IMR	Interchange Modification Report
LOS	Level of Service
MUTCD	Manual on Uniform Traffic Control Devices
NEPA	National Environmental Policy Act
PCES	Project Cost Estimating System
PHF	Peak Hour Factor
PPTA	Public-Private Transportation Act (1995)
ROD	Record of Decision
TSM	Transportation System Management
VDOT	Virginia Department of Transportation
YOE	Year of Expenditure