Traffic Impact Study
West Village Conceptual Plan

Prepared by: City of Lee's Summit
Dated: September 2018

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1.0 INTRODUCTION

This report studies traffic impacts associated with proposed commercial development (and Fire Station #3) along the west side of Pryor Road between Chipman Road and 3rd Street in Lee's Summit, Missouri. The objective of this study is to evaluate operations at study intersections for the scenarios detailed below. The report will review roadway conditions and consider potential impacts of the proposed development regarding turn lanes, storage bays, and intersection control methods. Study intersections include:

- Pryor Road and Chipman Road
- Pryor Road and O'Brien Road
- Pryor Road and Shamrock Avenue
- Pryor Road and 3rd Street
- Proposed Commercial Driveways along Pryor Road (within this development)

The two scenarios that were analyzed as a part of this study are as follows:

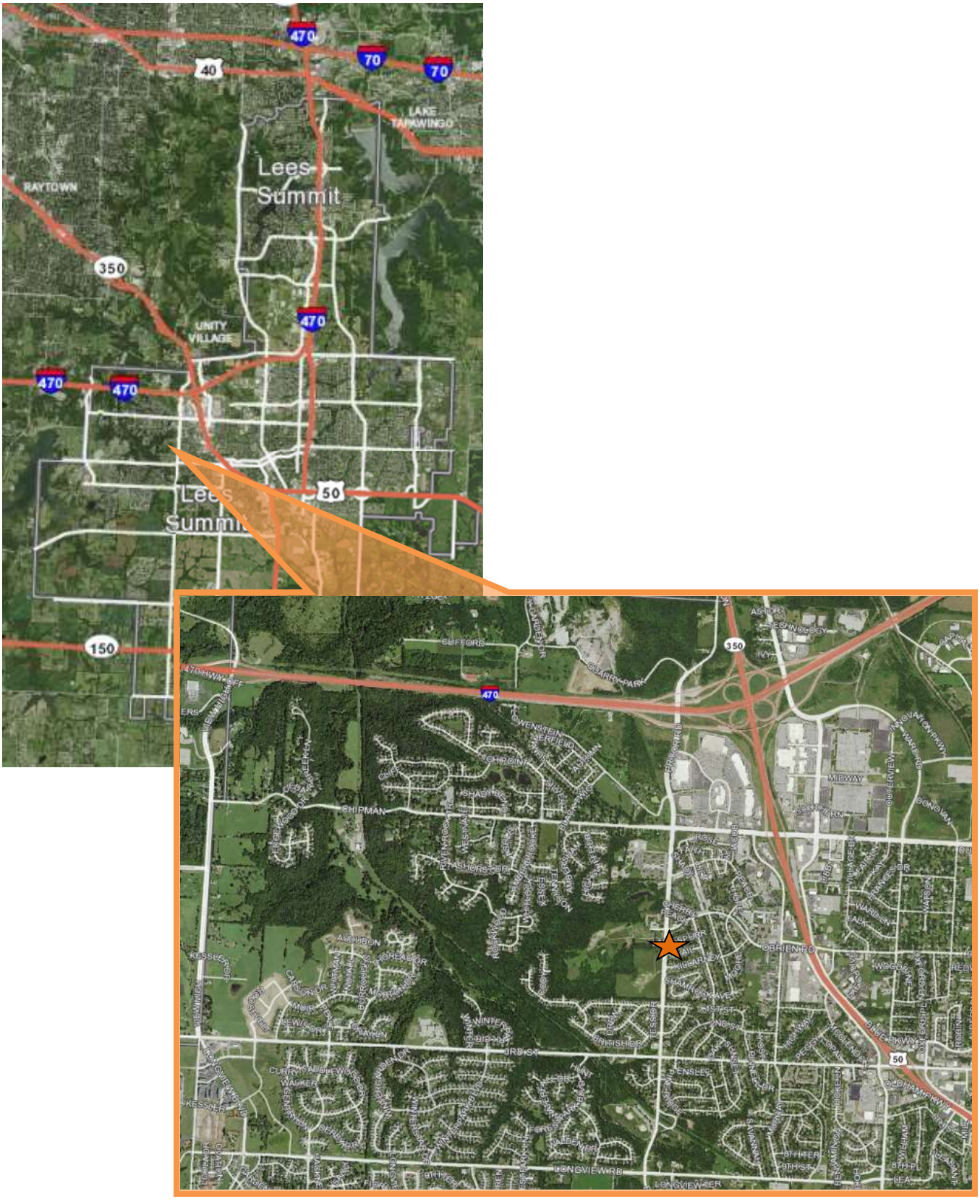
- Existing Conditions
- Existing plus Approved Development Conditions
- Existing plus Approved plus Proposed Development Conditions

The location of the proposed development is shown on the vicinity map in **Figure 1**.

The development application includes a preliminary development plan for the Fire Station and conceptual development plan for the remainder of the site. The Fire Station generates negligible traffic and all associated roadway improvements necessary to comply with the *Access Management Code* are planned with the City's Capital Improvement Project for the Fire Station and/or also conditions of Approved Development that share the same access (i.e. Shamrock Ave.). A separate analysis of the Fire Station from the commercial development, or preliminary plan from conceptual plan, is unnecessary since the operations are effectively reported in the Existing plus Approved Development scenario.

The conceptual plan was not phased, but a phased analysis may be appropriate in an updated/amended and future traffic impact study for the site to better manage any recommended improvements mitigating the development impact at such time as a preliminary development plan is submitted for consideration. Absent a comprehensive preliminary development plan for the entire conceptual plan, any and all recommendations to support the conceptual plan should be conditions of any part proposal.

FIGURE 1
Location Map



2.0 TRAFFIC DATA

The traffic volume and turning movement data used in this study for the AM and PM peak hour was obtained from the Woodside Ridge Traffic Impact Study, dated July 25th, 2018. Those intersection turning movement counts were conducted during the AM and PM peak hour periods on Tuesday, May 22nd, 2018 at the following intersections:

- Pryor Road and Chipman Road
- Pryor Road and O'Brien Road
- Pryor Road and Shamrock Avenue
- Pryor Road and 3rd Street

Existing north/south through traffic was assigned to the adjacent intersections and driveways along Pryor Road and balanced between intersections in consideration of other access and existing development nearby.

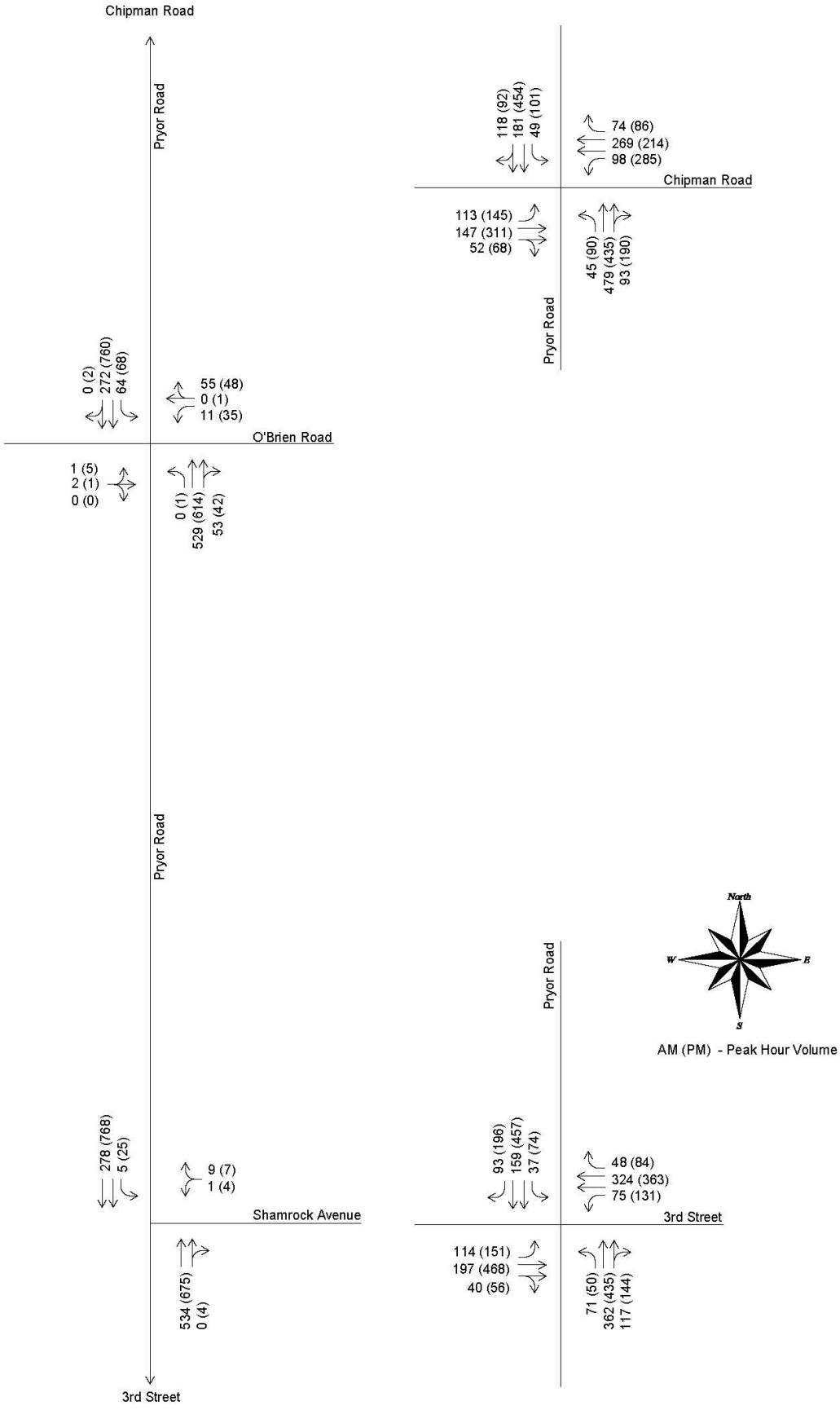
Based on the data collected, the peak hour periods for the study area were determined to be 7:00-8:00 AM and 5:00-6:00 PM. The existing peak hour volumes at the study intersections are illustrated in **Figure 2**. Count data used for this study can be found in **Appendix A**.

Existing signal timing information for the signals within the study area was obtained using the Mid-America Regional Council's (MARC) Operation Green Light Central Traffic Control System (TransSuite).

Development in the vicinity of the proposed development which is either approved or pending approval based on submitted preliminary development plan/preliminary plat application (and unbuilt) includes the Woodside Ridge Project. Woodside Ridge is a single family residential subdivision located immediately adjacent to the proposed development. Trip generation and distribution associated with Woodside Ridge was obtained from the Woodside Ridge Traffic Impact Study. Those trips (and any recommended/planned roadway improvements) are described in the Existing plus Approved Scenario.

FIGURE 2

Existing Peak HourVolumes



3.0 EXISTING CONDITIONS

To provide a baseline for comparative purposes and to assess the impact of the proposed development, traffic control operations were reviewed at the study intersections given existing conditions.

Existing Network Characteristics

Five roadways within the study area were considered in the analysis: Pryor Road, Chipman Road, O'Brien Road, Shamrock Avenue, and 3rd Street. Current roadway network characteristics are summarized in **Table 1** below. The functional classification for each roadway is defined in the City of Lee's Summit Functional Classification Map from the *Thoroughfare Master Plan*. The intersections of Pryor Road with Chipman Road, O'Brien Road, and 3rd Street are signalized. The intersection of Pryor Road with Shamrock Avenue operates under two-way stop control for the east/west movements.

TABLE 1: EXISTING ROADWAY NETWORK SUMMARY

Roadway	Functional Classification	Section	Median Type	Posted Speed
Pryor Road	Major Arterial	4-Lane	Raised	35 mph
Chipman Road	Major Arterial	4-Lane	Raised east of Pryor Road, no treatment west of Pryor Road	35 mph
O'Brien Road	Residential Collector	2-Lane	n/a	25 mph
Shamrock Avenue	Local	2-Lane	n/a	25 mph
3rd Street	Major Arterial	4-Lane	No treatment*	35 east of Pryor Road, 40 mph west of Pryor Road

**A raised median is planned along 3rd Street east of Pryor Road with a current capital improvement project.*

Existing Conditions Assessment

Existing Access Management: The City of Lee's Summit *Access Management Code* was used to identify existing non-compliant conditions applicable to minimum separation of intersections/driveways, sight distance, driveway depth, and access control along Pryor Road where proposed trips may use existing roadways and driveways. Access management is a critical element of roadway safety and operational capacity. Access management criteria in the *Access Management Code* are principally dependent on roadway classifications (a system to characterize and plan roadways based on volume, capacity, speed, and desirable function where access and mobility expectations significantly vary).

The existing roadways along Pryor Road noted in **Table 1** comply with the *Access Management Code* spacing criteria with the lone exception of Shamrock Avenue. The intersection of Shamrock Avenue is located approximately 600 feet north of the intersection of 1st Street/Sterling Drive. Both intersections have full access at Pryor Road. The minimum intersection separation should be 660 feet. However, a 10% deviation is permitted in the code. The location is within 10% of the minimum

distance and does not impede available space for code required turn lanes (absolute minimum dimensions).

Existing Signal Warrants: A traffic signal may be justified if traffic conditions meet any of the applicable nine signal warrants described in the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD). The MUTCD provides criteria for conducting an engineering study to determine whether a traffic signal is appropriate at an intersection. An intersection that meets one or more warrants for traffic signal control may not necessitate traffic signal installation, but should be considered based on engineering judgment and absent warranting conditions a traffic signal shall not be provided.

For this study, Warrants 2 and 3 were reviewed under existing conditions to determine if alternative control measures should be pursued for the currently unsignalized intersection of Pryor Road and Shamrock Avenue. The intersection of Shamrock Avenue at Pryor Road is approximately a quarter mile from the signal at O'Brien Road to the north and a third mile from the signal at 3rd Street to the south, both of which exceed the minimum separation of signals described in the *Access Management Code*. All other study intersections are currently signalized or have limited use (e.g. restricted to right-in/right-out traffic by a raised median along Pryor Road). Based on data collected, neither the Four-Hour Vehicular Volume Warrant (Warrant 2) nor the Peak Hour Warrant (Warrant 3) meets the necessary criteria to warrant a traffic signal at the intersection of Pryor Road and Shamrock Avenue.

Existing Turn Lane Evaluation: The City of Lee's Summit *Access Management Code* (AMC) was used to determine if any turn lanes may be required that do not currently exist simply based on code requirements. The code provides direction on when turn lanes shall or should be provided considering intersection control, roadway classification and/or traffic volumes. The code also provides minimum standard design capacity (i.e. storage) associated with left-turn and right-turn lanes for various types of roadways and intersections.

Based on information provided in the AMC, a left-turn lane is required for each approach at signalized intersections. Currently, there is no eastbound left-turn lane provided at the intersection of Pryor Road and O'Brien Road. Peak hour traffic volumes for the eastbound movement are very low, thus capacity analysis was also reviewed for existing conditions to determine if a dedicated left-turn lane may be recommended based on operational delay. This assessment is summarized in the Existing Capacity Analysis subsection.

Dual left-turn lanes are stipulated in the AMC (and should be planned) for all approaches of an arterial/arterial intersection, which would include the intersections of Pryor Road with Chipman Road and Pryor Road with 3rd Street. Neither of these intersections currently provides dual left-turn lanes; though all approaches provide a single dedicated left-turn lane. The left-turn lanes currently provided at these intersections do not meet the minimum recommended left-turn lane storage distance of 250 feet for arterial/arterial intersections, set forth in the AMC, with the exception of the southbound and westbound movements at Pryor Road and Chipman Road and the southbound approach at Pryor Road and 3rd Street. Capacity analysis was also reviewed for existing conditions, summarized in the Existing Capacity Analysis subsection, to determine if providing additional storage and/or dual left-turn lanes is recommended based on existing vehicle queues and operational delays.

Right-turn lane requirements are dependent on roadway classification and minimum traffic volumes outlined in the *Access Management Code*. Based on this information, a right-turn lane would be required for the following movements for existing conditions:

- Pryor Road and 3rd Street
    - Eastbound and northbound movements

- Pryor Road and O'Brien Road
    - Northbound movement
- Pryor Road and Chipman Road
    - Southbound, northbound and eastbound movements

Capacity analysis was also reviewed in the Existing Capacity Analysis subsection for the existing conditions to determine if providing the omitted right-turn lane at any of these locations is recommended based on existing operations and queuing reports.

Existing lane configurations and traffic controls for the study intersections are illustrated in **Figure 3**.

Existing Capacity Analysis

Capacity analysis was performed for the study intersections utilizing the existing lane configurations and traffic control. Analysis was conducted using Synchro, Version 9, based on the *Highway Capacity Manual* (HCM) delay methodologies. In order to utilize the latest methodology, U-turn movements at the signalized intersections were coded as left-turn movements during analysis. Due to the low volume of U-turn movements at study intersections, considering U-turn movements as a left-turn movement is expected to have minimal impact on results. For simplicity, the amount of control delay is equated to a standardized measure of performance, a grade or Level of Service (LOS) based on thresholds of driver acceptance. The amount of delay is assigned a letter grade A through F, LOS A representing little or no delay and LOS F representing very high delay. The City of Lee's Summit has adopted a policy describing adequate level of service; LOS C for traffic signal controlled intersections and LOS D for stop controlled movements (LOS E may be acceptable). **Table 2** shows the delays associated with each LOS grade for signalized and unsignalized intersections, respectively.

TABLE 2: INTERSECTION LOS CRITERIA

Level-of-Service	Average Control Delay (seconds)	
	Signalized	Unsignalized
A	≤ 10	≤ 10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	> 80	> 50

Highway Capacity Manual (HCM 6th Edition)

The signalized study intersections of Pryor Road and Chipman Road, Pryor Road and O'Brien Road, and Pryor Road and 3rd Street are operating at LOS C or better overall during both the AM and PM peak hour periods. Furthermore, all individual movements at these intersections are operating at a LOS C or better during the AM and PM peak hour periods with exception of the eastbound through movement during the PM peak hour along Chipman Road at Pryor Road. This movement exhibits a LOS D, but with some minor traffic signal timing adjustments that balance the delay to other signal phases/traffic movements, it may achieve LOS C. The amount of delay and reported vehicle queues for this movement are acceptable and no improvements recommended at this time. Individual movements do not require LOS C or better performance based on policy at signal controlled intersections. The individual movements at the unsignalized study intersection of Pryor Road Shamrock Avenue are operating at a LOS C or better during the AM and PM peak hour periods.

The existing capacity analysis summary is illustrated in **Figure 4**. Details provided in **Appendix B**.

Existing operations were also reviewed to determine if turn lane improvements (e.g. capacity improvements), given direction provided in the *Access Management Code*, should be provided based on delay and vehicle queuing. Level of Service as well as 95th- percentile queue lengths were considered for each movement, adjacent movement and overall intersection. The 95th-percentile queue represents the queue length that has a 5 percent probability of being exceeded during the peak hour. The existing queues are also illustrated in **Figure 4** with the LOS results. Detailed results may be found in **Appendix B**.

Based on the operational analysis, all study intersections are operating at acceptable levels of service with current intersection configurations. Existing through movement queues for some approaches were found to extend beyond the adjacent turn lane storage, potentially blocking entry to the turn lane during a portion of peak hour periods. This occurrence is minimal, marginal and only reported during the PM peak hour. These conditions are located at the intersections of Pryor Road with Chipman Road (northbound movement), O'Brien Road (southbound movement), and 3rd Street (northbound and eastbound movements). However, the delays associated with these movements are still believed to be acceptable. Furthermore, some opportunity for additional turn lane capacity is physically limited by adjacent access, utilities, or roadway geometry as described in more detail below. Existing queues for turning movements are contained within the provided storage length at all studied locations. Although existing turn lanes or storage lengths may not fully meet minimum criteria provided in the *Access Management Code* (AMC) or may be periodically blocked by adjacent queues, all intersections are operating at an acceptable level of service. Note that existing conditions often pre-date adoption of the AMC. Turn lane improvements likely provide safety and operational benefits; however, turn lane improvements are not necessary at this time due to the acceptable operations under current conditions and physical limitations that outweigh likely benefits to constructing the minimums described in the AMC. A summary of existing conditions pertaining to turn lanes, especially all situations where the code has not been met, is provided below:

- Pryor Road and Chipman Road
    - Northbound right-turn lane not present and not critical at this time.
        - Current overall intersection operations are acceptable during both peak hours.
        - Current movement operations are acceptable (LOS C or better during the AM and PM peak hours) with current lane configurations.
        - Through queues are shared with right-turn movements and lane utilization is poor. Though the left-turn lane may be blocked by through traffic, lane use typically favors the outside lane, thus the turn lane is rarely blocked.
        - A right-turn lane in the future could reduce through queue distances, providing more reliable access to the adjacent left-turn lane and more efficient intersection operations.
        - A right-turn lane is likely impeded by existing utilities in the southeast corner of the intersection. A steel, high-voltage, electrical transmission pole is located within the probable construction area. Relocation, if required, should not be pursued without a significant need to provide acceptable level of service.
    - Northbound left-turn lane present, but less than minimum typical capacity. No extension recommended at this time.
        - Left-turn queue distances are less than current storage capacity.
        - Turn lane may be extended without conflict though median reconstruction, but not necessary for modeled queues.
        - Adjacent queue influences described above do not exhibit significant impact to entry in its current capacity.

    - Southbound and Eastbound right-turn lanes not present and not critical at this time.
        - Current overall intersection and movement operations are acceptable (LOS C or better during the AM and PM peak hours) with current lane configurations.
        - Through/right-turn queues do not block entry into adjacent left-turn lanes.
        - Existing major utility infrastructure in the northwest quadrant of the intersection impacts the feasibility of a southbound right-turn lane installation.
    - Dual left-turn lanes not present or necessary at this time.
        - Current left-turn operations are acceptable (LOS C or better during both peak hours) as single lefts.
        - Providing dual left-turn lanes would require significant intersection and roadway reconstruction impacting adjacent property since the medians are not wide enough to accommodate a dual left-turn lane condition.
        - Existing left-turn 95th-percentile queues are contained within storage lanes.
        - Refer to left-turn lane assessment above for single lefts that are adequate.
- Pryor Road and O'Brien Road
    - Northbound right-turn lane not present and not necessary at this time.
        - Current intersection and movement operations are acceptable (LOS B during the AM and PM peak hours) with current lane configurations.
        - Through/right-turn queues do not block access to the adjacent left-turn lane.
    - Eastbound left-turn lane not present and dependent on adjacent development.
        - Current movement operations are acceptable (LOS C during the AM and PM peak hours) with current lane configurations.
        - Turn lane will be required to support any development west of Pryor.
- Pryor Road and 3rd Street
    - Northbound right-turn lane not present or necessary at this time.
        - Current intersection and movement operations are acceptable (LOS C or better during the AM and PM peak hour) with current lane configurations.
        - Through queues are shared with right-turn movements on a multi-lane approach. Though the left-turn lane may be blocked by through traffic on occasion, the left-turn volume and queues are minor.
    - Eastbound, Westbound and Northbound left-turn lanes are present, but each has less than minimum typical capacity. No extension of any of these left-turn lanes recommended at this time.
        - Left-turn queue distances are less than current storage capacity.
        - Adjacent through queues do not have a measurable impact to access any of these left-turn lanes as exists.
        - Eastbound left-turn lane may be extended without conflict through pavement marking modifications, but not necessary for modeled queues.
        - Westbound left-turn lane and Northbound left-turn lane cannot be extended due to opposite left-turn lanes provided at adjacent intersections unless those intersections are further limited in access by raised medians along Pryor Road and 3rd Street to eliminate all adjacent left-turn movements.
    - Dual left-turn lanes not present or necessary at this time.
        - Current overall intersection and individual left-turn operations are acceptable (LOS C or better during both peak hours) as single lefts.
        - Providing dual left-turn lanes would require significant intersection and roadway reconstruction since there are no medians at this location.
        - Refer to assessment of single left-turn lanes above in which current capacity is adequate.

No turn lane or traffic control improvements are recommended based on the Existing Conditions analysis.

FIGURE 3

Existing Lane Configuration and Traffic Control

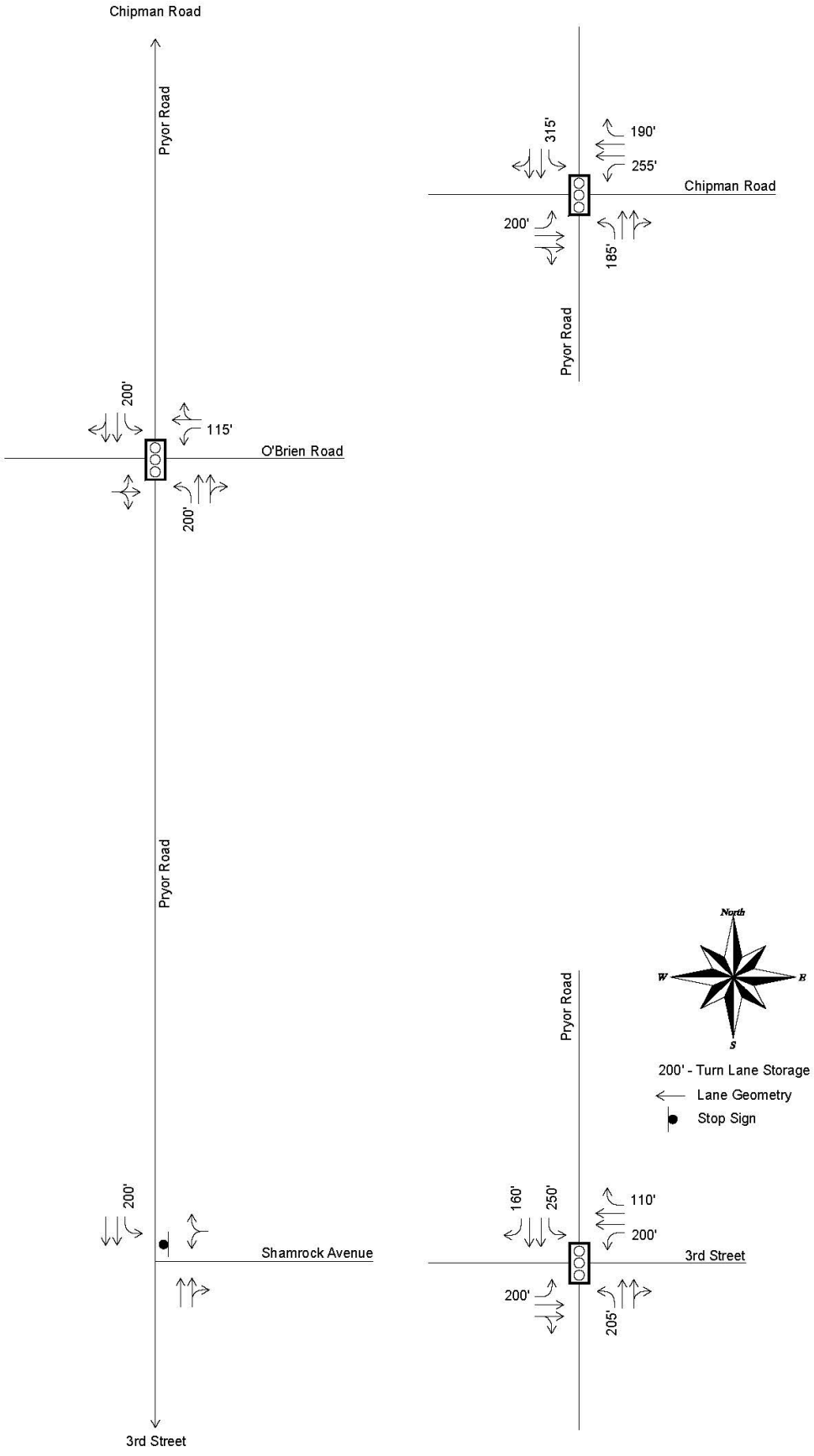
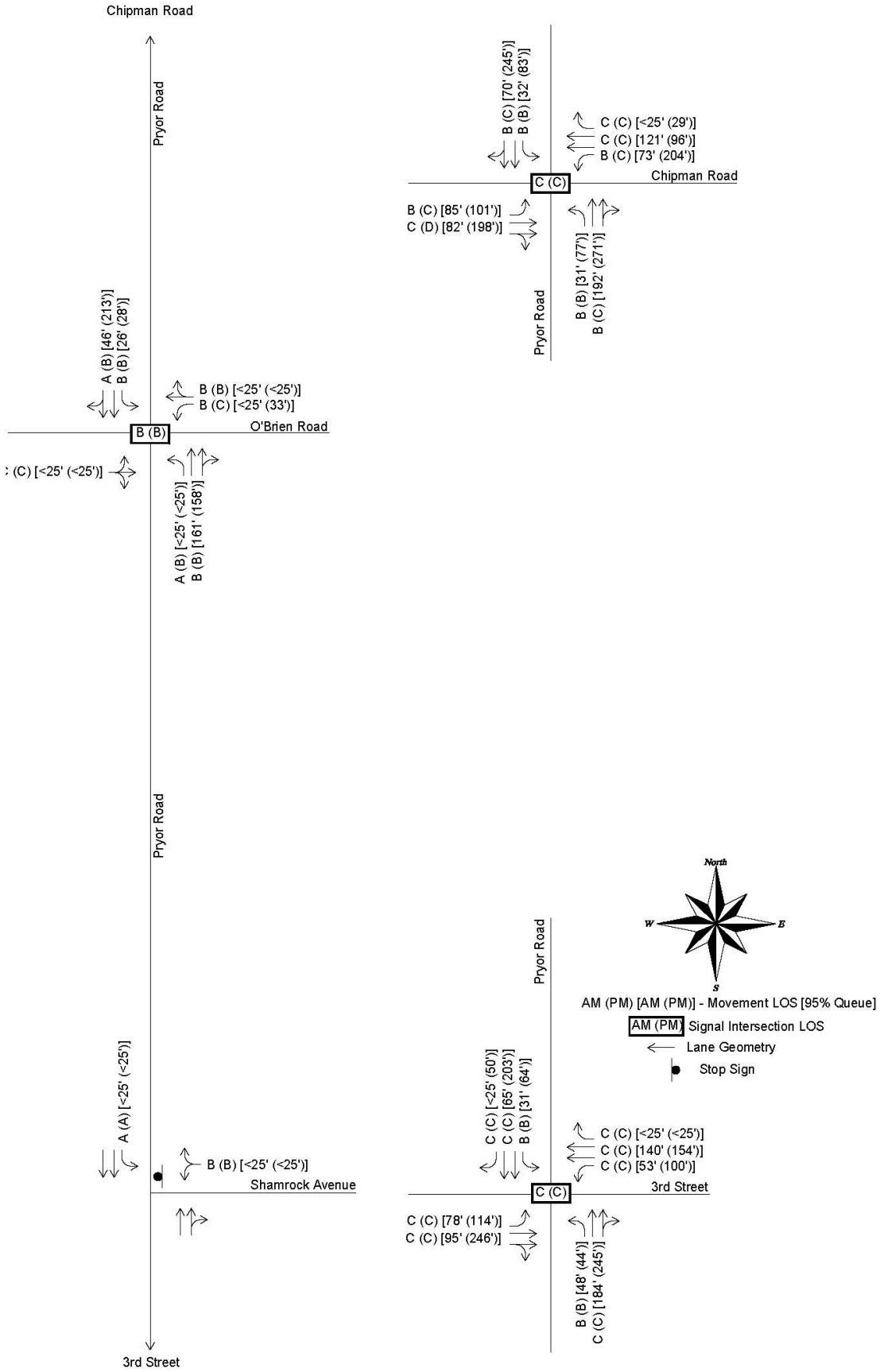


FIGURE 4

Existing Level of Service/Queues



4.0 EXISTING PLUS APPROVED DEVELOPMENT CONDITIONS

This scenario considers approved development (which includes applications pending City Council ordinance approval with Planning Commission recommendation) located west of Pryor Road adjacent to the proposed development. Approved development, Woodside Ridge, consists of 206 single-family residential units and has been studied by Olsson Associates; a traffic impact study dated July 25, 2018, in consideration of the associated Preliminary Development Plan/Preliminary Plat. The site plan for Woodside Ridge is illustrated in **Figure 5**.

Access to Woodside Ridge will be provided along Pryor Road from the extension of Ashurst Drive, O'Brien Road, and Shamrock Avenue. O'Brien Road and Shamrock Avenue will share access with the proposed development, West Village. Other local roadway connections to Woodside Ridge from surrounding residential subdivisions will also be completed as planned.

O'Brien Road, which currently terminates approximately 365 feet west of Pryor Road, will extend west into Woodside Ridge. O'Brien Road will be reconstructed and include an eastbound left-turn lane as part of the Woodside Ridge development plan. A 200-foot (plus taper) southbound right-turn lane will be constructed along Pryor Road at O'Brien Road too. Shamrock Avenue, which currently has no access west of Pryor Road, will extend westward. As part of the City's Fire Station #3 Replacement Project, roadway improvements are planned for the intersection of Pryor Road and Shamrock Avenue including a northbound left-turn lane and eastbound left-turn lane at this location. These planned City improvements were considered complete under the evaluation of Woodside Ridge (Existing plus Approved Development Scenario) and likewise are considered complete for the proposed development, West Village, impact study (Existing plus Approved plus Proposed Development Scenario). The proposed roadway connections are shown to align with the existing road network and are consistent with requirements provided in the *Access Management Code*.

The trip generation and distribution associated with Woodside Ridge is detailed in **Appendix C** and associated trips are included the peak hour traffic volumes shown in **Figure 6**. Traffic Volumes for Existing plus Approved Development, Level of Service and Queuing reports as presented with the Woodside Ridge Project are also included in **Appendix C** (Woodside Ridge Traffic Impact Study, Existing plus Development Scenario, Figures 6, 7 and 9).

Existing Conditions Assessment

Existing plus Approved Development Access Management: The approved development does not change the access assessment provided in the report section for existing conditions; no new intersections are proposed along Pryor Road for the approved development subject to this study.

Existing plus Approved Development Signal Warrants: As discussed in Section 3 of this report, Warrants 2 and 3 were also reviewed for Existing plus Approved Development at the unsignalized intersection of Pryor Road and Shamrock Avenue. All other study intersections are currently signalized or have limited use (e.g. restricted to right-in/right-out traffic by a raised median along Pryor Road). Based on the traffic impact study for Woodside Ridge, neither the Four-Hour Vehicular Volume Warrant (Warrant 2) nor the Peak Hour Warrant (Warrant 3) meets the necessary criteria to warrant a traffic signal at the intersection of Pryor Road and Shamrock Avenue.

Existing plus Approved Development Turn Lane Evaluation: The approved development will fully comply with the City of Lee's Summit *Access Management Code* (AMC) as it applies to the study intersections for West Village; and it will provide all required turn lanes as noted in the project description for Woodside Ridge. These turn lanes (i.e. eastbound left-turn and southbound right-turn at the O'Brien intersection and northbound left-turn lane and eastbound left-turn lane at the

Shamrock intersection) were included in the analysis of Existing plus Approved Development (i.e. Woodside Ridge Traffic Impact Study Existing plus Development Scenario). The approved development will not provide additional turn lanes or turn lane capacity contemplated in consideration of AMC minimum criteria for the intersections of Pryor Road at Chipman Road or 3rd Street, discussed in Section 3 of this report, for existing conditions. The approved development does not directly change the physical condition of these intersections to warrant the turn lane improvements that are omitted in existing conditions solely based on roadway functional classifications absent an operational need in which the improvement is provided to mitigate the developments impact to acceptable conditions. An evaluation of needed additional turn lane capacity to comply with the level of service and queueing reports was completed in the Capacity Analysis for Existing plus Approved Development subsection.

Existing Plus Approved Development Capacity Analysis

Capacity analysis was performed for the study intersections utilizing the information provided in the Woodside Ridge Traffic Impact Study and conditions of its approval for the Existing plus Approved Development Scenario. Analysis was conducted using Synchro, like was done for Existing Conditions, and the same was done for the Woodside Ridge Project. Due to minor changes in signal timing/cycle optimization, assumed adjustment factors or modeling technique/versions, the results may be slightly different between those reported herein and those reported in the Woodside Ridge Traffic Impact Study; though the traffic volume and lane configurations are consistent. Refer to Section 3 for an explanation of the standardized performance measurement system (Level of Service) and queues pertaining to traffic operations and the City's performance goals.

Results of the capacity analysis indicate similar operations to those reported for existing conditions. All of the study intersections are expected to exhibit a level of service (LOS) meeting or exceeding the City's identified measure of adequate conditions for Existing plus Approved Development in consideration of the improvements required and previously described. A summary of Level of Service and vehicle queuing is illustrated in **Figure 7**.

The impact of approved development has not significantly changed the operational level of service or queues at the intersections of Pryor Road and Chipman Road or 3rd Street to such degree which previously unsupported turn lanes (or extension thereof) warrant reconsideration. The reported queues for each turning movement are contained within available turn lane storage for that particular movement in both peak hours. Through lane vehicle queues (sometimes shared with right-turn traffic) do not block access to adjacent turn lanes during most of the peak hours and are consistent with the assessment provided in Section 3 for existing conditions. Where adjacent queues block entry to the turn lane, it has a probability of occurring less than 5% of the time during a peak hour and overall LOS still exceeds the City's goals.

The following improvements are restated for reference and necessary in support of Existing plus Approved Development. These improvements are included in the conditions of approved development approval (some shared with the City's Capital Improvement Plan for Fire Station #3):

- Southbound right-turn lane with 200' of storage plus taper at Pryor Road and O'Brien Road
- Eastbound left-turn lane (reconstruction of O'Brien) at Pryor Road and O'Brien Road
- Northbound left-turn lane with 250' of storage plus taper at Pryor Road and Shamrock Ave.
- Eastbound left-turn lane (construction of Shamrock) at Pryor Road and Shamrock Ave.

No other road improvements are recommended for the Existing plus Approved Development scenario.

FIGURE 5

Approved Development Site Plan

FIGURE 6

Existing Plus Approved Development Traffic Volumes

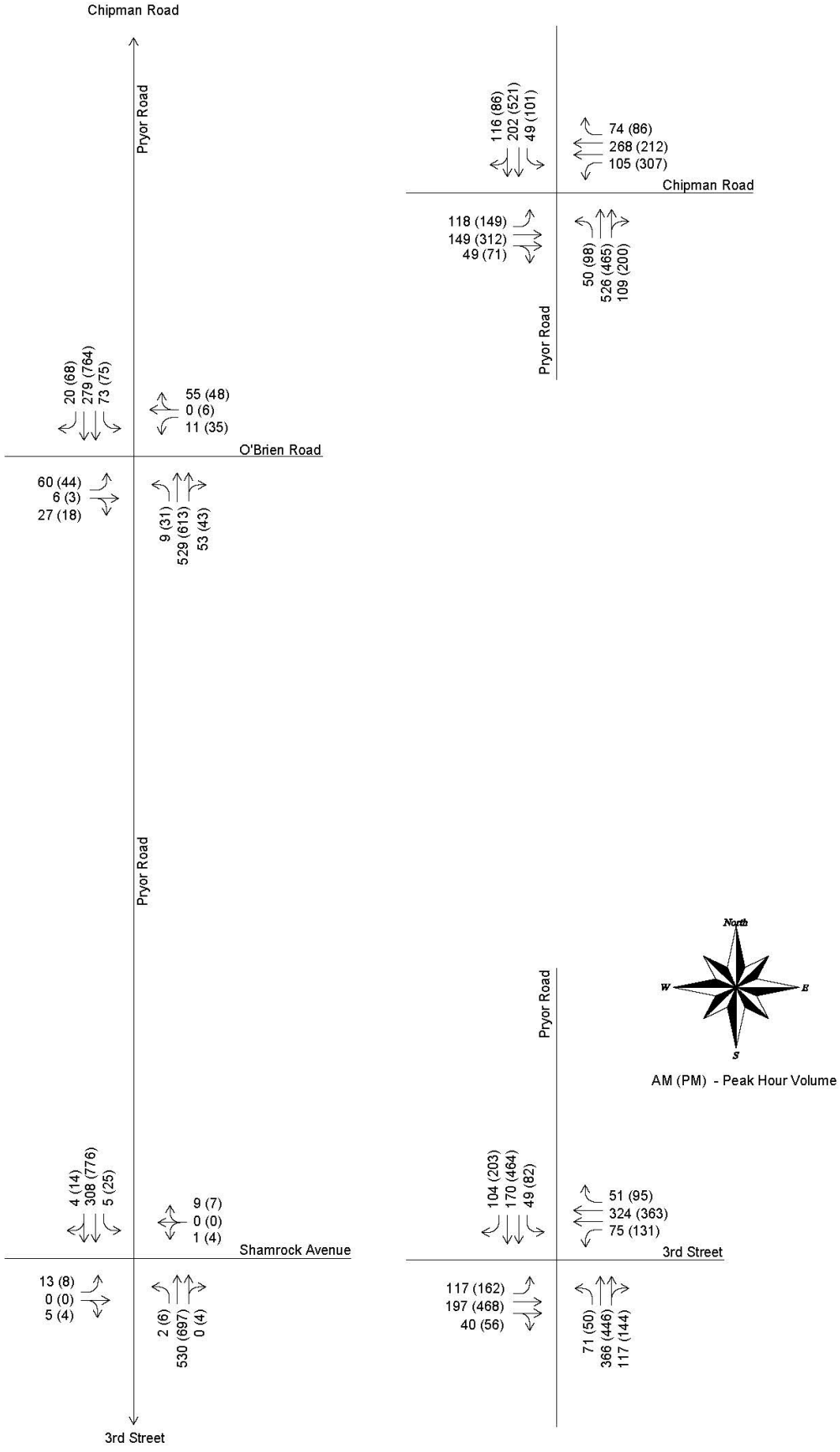
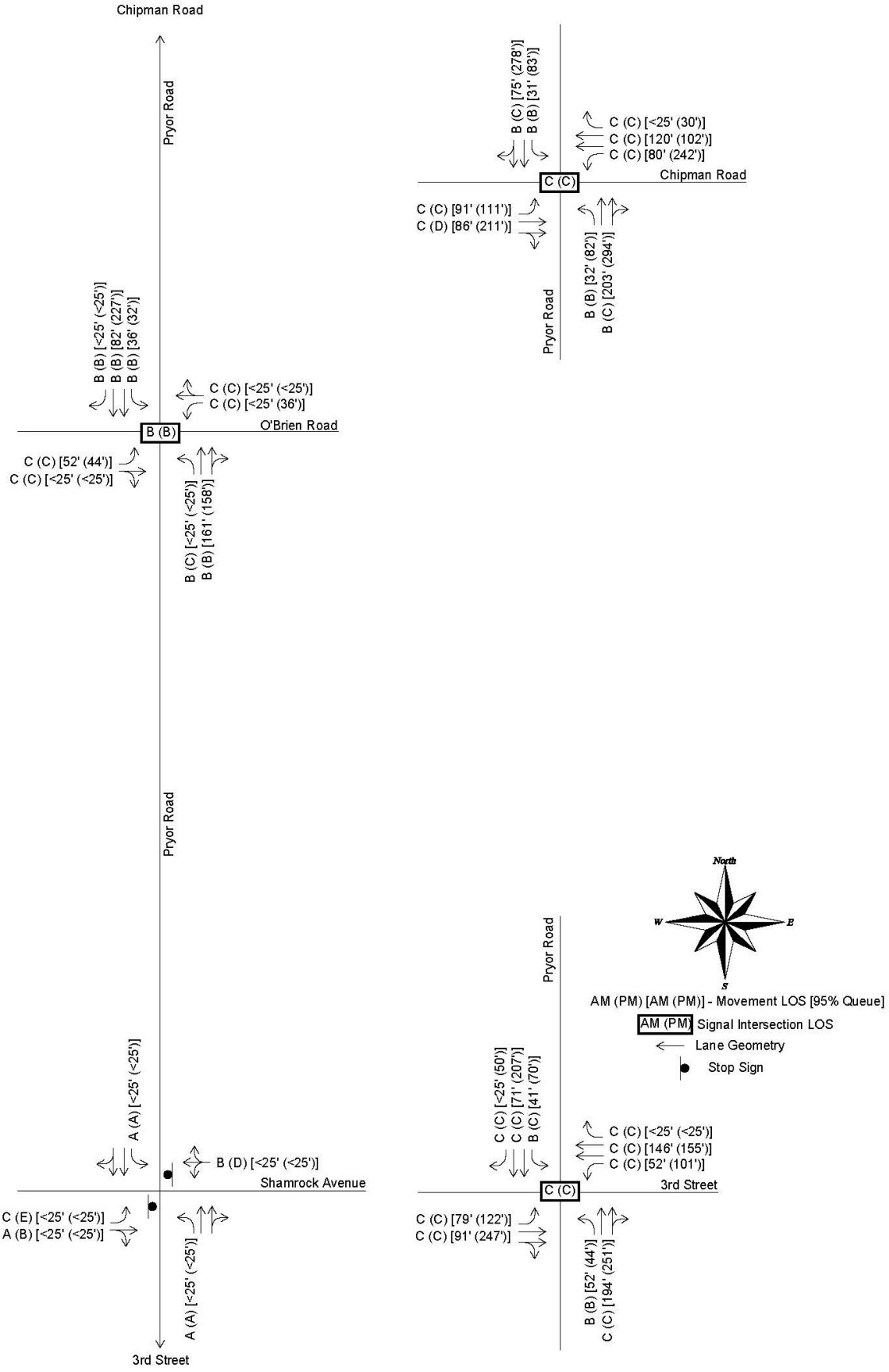


FIGURE 7

Existing Plus Approved Development Level of Service/Queues



5.0 EXISTING PLUS APPROVED PLUS PROPOSED DEVELOPMENT CONDITIONS

This scenario considers the subject proposed development (named West Village) located west of Pryor Road between Chipman Road and 3rd Street. The proposed development consists of several commercial land uses. The site plan associated with the proposed development is illustrated in **Figure 8** and land uses tabulated in **Table 3**.

Access to the proposed development will be provided along Pryor Road from O'Brien Road and Shamrock Avenue. O'Brien Road and Shamrock Avenue will provide access to the approved development (Woodside Ridge) and to the proposed development (West Village). Both streets will be constructed in association with the approved development and/or the City's Fire Station #3 Replacement Capital Improvement Project. Additional right-in/right-out commercial driveway accesses along Pryor Road are planned in the proposed development plan.

The proposed roadway connections are shown to align with the existing road network and are consistent with requirements provided in the *Access Management Code* (AMC). All proposed commercial driveways comply with the AMC criteria, including location, separation, sight distance, and depth as shown on the site plan.

The proposed development has been shown as a preliminary development plan for the Fire Station and conceptual development plan for the remainder of the site. No other phasing of the development has been put forward. An assessment of the Fire Station has negligible traffic generation. The operational results of Existing plus Approved are assumed the same with a Fire Station using the same roadways and roadway improvements. No other improvements are necessary to support the Fire Station project. The remainder of the proposed development traffic impact is reviewed in the following subsections for Existing plus Approved plus Proposed Development Conditions.

Proposed Development Trip Generation and Distribution

To determine the impact of potential site traffic on the roadway network, expected trips associated with the proposed development were forecasted and applied to the study intersections. The Institute of Transportation Engineers (ITE) provides methods for estimating traffic volumes of common land uses in the *Trip Generation Manual* (10th Edition). Based on the ITE *Trip Generation Manual*, trip generation characteristics were developed for each type of land use (as most applicable) shown on the proposed site. Land uses and trip generation characteristics expected for the site are shown in **Table 3**. Detailed ITE trip generation information can be found in **Appendix D**.

TABLE 3: PROPOSED DEVELOLPMENT TRIP GENERATION

Land Use	Size (SF)	Average Weekday	AM Peak Hour			PM Peak Hour		
			Total	Enter	Exit	Total	Enter	Exit
Fire Station	16,050	64	4	2	2	8	2	6
General Office	27,000	298	52	45	7	33	6	27
Medical / Dental Office	78,600	2,735	219	171	48	272	76	196
Shopping Center	22,000	2,147	21	13	8	177	85	92
Supermarket	40,000	4,271	153	92	61	370	188	182
Pharmacy / Drugstore with Drive-Thru	16,000	1,747	61	32	29	165	83	82
Drive-in Bank	5,000	500	48	28	20	102	51	51
Total	NA	11,763	557	383	174	1127	491	636

Trips were distributed based on the anticipated land use and a review of existing traffic behavior within the study area. The trip distribution assumptions are consistent with those applied to the approved development, Woodside Ridge. **Table 4** describes general trip distribution for the site.

TABLE 4: PROPOSED DEVELOPMENT TRIP DISTRIBUTION

Route	Percent Distribution
Pryor Road (north)	45%
Pryor Road (south)	10%
Chipman Road (east)	15%
Chipman Road (west)	5%
3rd Street (west)	10%
3rd Street (east)	10%
O'Brien Road (east)	5%

The assigned trips generated by the proposed development are detailed in **Appendix D**. Existing plus Approved plus Proposed Development volumes are illustrated in **Figure 9**.

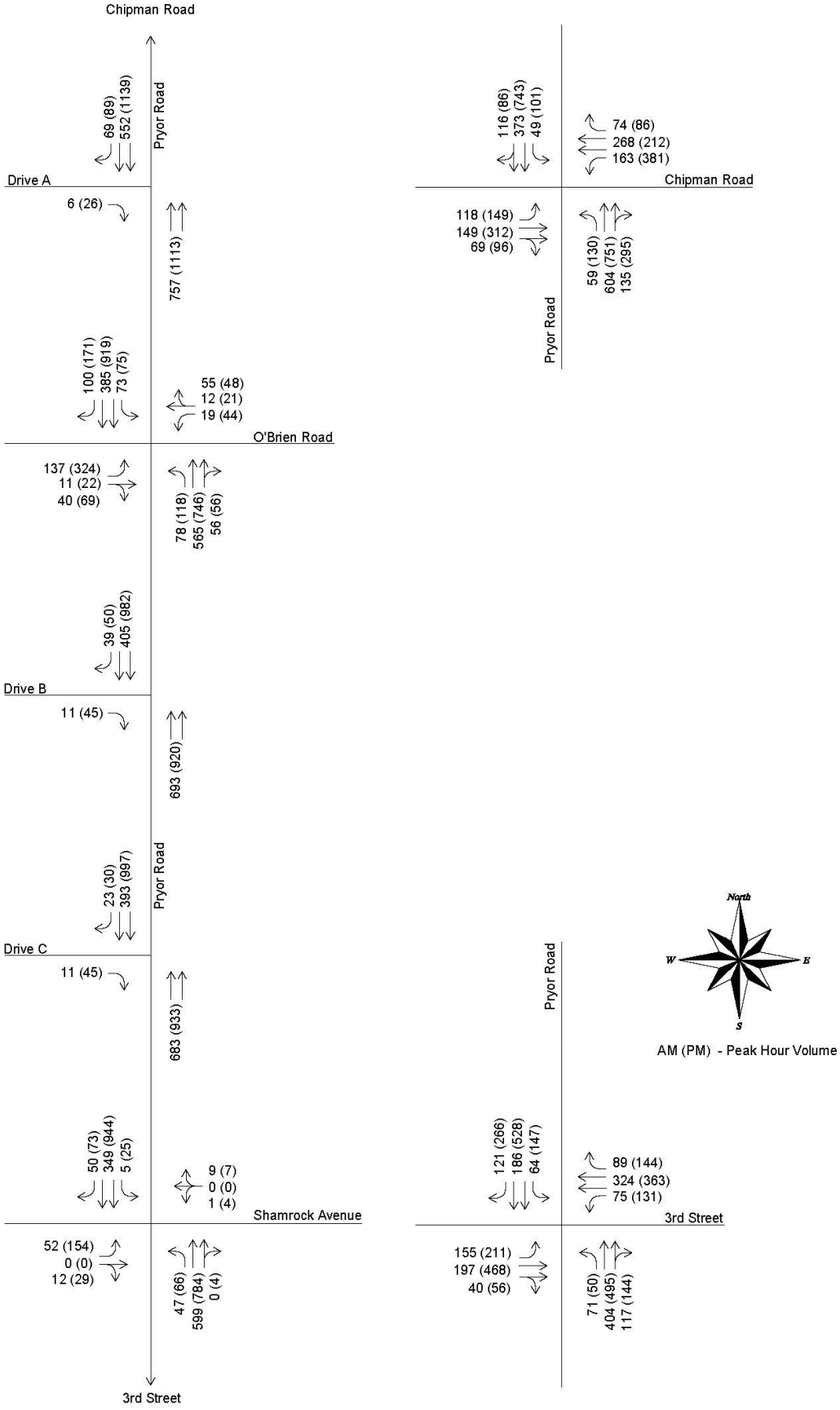
FIGURE 8

Proposed Development Site Plan

Site Plan Prepared by Olsson Associates (8/29/18)

FIGURE 9

Existing Plus Approved Plus Proposed Development Volumes



Proposed Development Conditions Assessment

Proposed Development Access Management: The City of Lee's Summit *Access Management Code* was used to identify existing and proposed non-compliant conditions applicable to minimum separation of intersections/driveways, sight distance, and access control along Pryor Road where proposed trips may use existing and/or proposed roadways and driveways. Access management is a critical element of roadway safety and operational capacity. Access management criteria in the *Access Management Code* (AMC) are principally dependent on roadway classifications (a system to characterize and plan roadways based on volume, capacity, speed, and desirable function where access and mobility expectations significantly vary). As shown on the proposed site plan, the commercial driveways are limited access to right-in/right-out and proposed right-turn lanes are compliant with the AMC. The driveway spacing along O'Brien Road and Shamrock Avenue are discussed in more detail in the subsections below. Individual private driveways serving the site have adequate depth from the public roadways as depicted on the site plan and any potential negative impacts to traffic circulation would be upon private property. The roadways serving the proposed development exist or will exist prior to development in association with the approved development scenario. There are no notable AMC omissions, deviations or waivers.

Traffic conditions were reviewed to identify any potential geometric improvements that could be attributed to additional traffic associated with the proposed development.

Existing plus Approved plus Proposed Development Signal Warrants: Considering Existing plus Approved plus Proposed Development traffic volumes, the intersection of Pryor Road with Shamrock Avenue is expected to meet the criteria for signalization during the PM peak hour period using the MUTCD Warrant 3 (peak hour warrant). Signal warrant analysis sheets can be found in **Appendix D**. The intersection is adequately spaced from adjacent traffic signals in support of traffic signal control. When a preliminary development plan is proposed in place of the studied conceptual development plan, this intersection should be further studied with more current data and land use projections. Any future traffic impact study inclusive of the concept may consider a phased scenario to better associate the signal need upon warranting development (e.g. the north portion of the development does not likely warrant a signal at Shamrock Avenue since it does not generate significant trip distribution to/from Shamrock Avenue.). If an additional traffic study is not completed for a preliminary development plan, a traffic signal is recommended based on the conceptual development plan studied for any portion of development within the subject concept. A traffic signal would mitigate the operational deficiencies reported in the Existing plus Approved plus Proposed Development Capacity Analysis subsection at the Pryor Road and Shamrock Ave. intersection.

Existing plus Approved plus Proposed Development Turn Lane Evaluation:

Left Turn Lanes: There is no new full access proposed. No new left-turn lanes are required in association with the proposed development. Existing left-turn lanes, including those assumed in place based on approved development, are further reviewed in the Existing plus Approved plus Proposed Development Capacity Analysis subsection for additional improvement based on operations and queuing.

Left-turn movements at the proposed commercial driveways (Drive A, Drive B and Drive C) shall be restricted to right-in/right-out by the existing raised median along Pryor Road. The proposed driveways along O'Brien Road (located approximately 215 feet west of Pryor Road, measured center-to-center) shall be restricted to right in / right out or be removed as discussed later in the report.

Left-turn lane improvements to the intersection of Pryor Road and Shamrock Road, which includes a

northbound left-turn lane and eastbound left-turn lane, will be installed as part of Approved Development. These turn lanes have been maximized in consideration of available space. In the absence of approved development and the City's Capital Improvement Project for Fire Station #3, the proposed development shall provide those improvements. The following left-turn lanes are recommended for the proposed development (these turn lanes are also conditions of approved development):

- Eastbound left-turn lane (reconstruction of O'Brien) at Pryor Road and O'Brien Road (storage required exceeds minimum shown for approved development based on queues)
- Northbound left-turn lane with 200' of storage plus taper (maximized space) at Pryor Road and Shamrock Ave.
- Eastbound left-turn lane (construction of Shamrock) at Pryor Road and Shamrock Ave.

These turn lanes and additional capacity recommended in support of the Proposed Development may be coordinated between development projects to minimize public disruption and reduce shared development costs.

Right Turn Lanes: Based on right-turn lane standards provided in the Lee's Summit *Access Management Code* and a review of Existing plus Approved plus Proposed Development peak hour turning volumes, a southbound right-turn lane with 150 feet of storage plus taper is recommended at the intersection of Pryor Road and Shamrock Avenue, Drive A, Drive B, and Drive C. A 200-foot plus taper southbound right-turn lane is required for approved development at the intersection of Pryor Road and O'Brien Road. However, if the approved development does not occur prior to the proposed development, the proposed development shall also need a 200-foot plus taper southbound right-turn lane along Pryor Road at O'Brien Road. All the aforementioned right-turn lanes have been included in the proposed development site plan and summarized below for recommendation in support of the proposed development:

- Southbound right-turn lane with 150' of storage plus taper along Pryor Rd. at Drive A
- Southbound right-turn lane with 150' of storage plus taper along Pryor Rd. at Drive B
- Southbound right-turn lane with 150' of storage plus taper along Pryor Rd. at Drive C
- Southbound right-turn lane with 200' of storage plus taper along Pryor Rd. at O'Brien Road
- Southbound right-turn lane with 150' of storage plus taper along Pryor Rd. at Shamrock Ave.

As discussed within the existing conditions scenario, several existing intersection turn lane configurations do not meet minimum standards provided in the *Access Management Code*. Existing plus Approved plus Proposed Development operations and queues were reviewed for these movements (described in the next section) and turn lane recommendations were made as appropriate.

Existing plus Approved plus Proposed Development lane configurations and traffic control for the study network are illustrated in **Figure 10**.

Existing plus Approved plus Proposed Development Capacity Analysis:

Capacity analysis was performed for Existing plus Approved plus Proposed Development conditions using the methodologies described previously. The analysis assumed approved and proposed turn lanes associated with approved development and proposed site plan. Proposed turn lanes were assumed to comply with the *Access Management Code* (AMC) criteria using minimum storage lengths or longer as may be conditioned for queuing demand.

Results of the capacity analysis indicate worsened operations at the studied intersections compared to Existing plus Approved Development conditions. However, all the signalized study intersections are expected to operate at LOS C or better overall during both the AM and PM peak hour periods with exception of the Pryor Road and Chipman Road PM period (LOS D). The intersection of Pryor Road and Chipman Road also exhibits severe vehicle queuing issues during both peak hours, especially the PM peak period, which may be more problematic than the LOS indicates. The LOS and queues can be mitigated to acceptable conditions by the construction of a northbound right-turn lane and eastbound right-turn lane. A northbound right-turn lane may be in conflict with major utility relocations. These right-turn lanes would be adequate with minimum storage lengths required by the AMC.

Individual traffic movements at traffic signals do not require a LOS C or better according to policy, but most of the studied intersections achieve this goal in both peak hours. An operational analysis and queuing assessment of each traffic movement was completed to evaluate existing and proposed turn lane capacity improvement needs. A few signal controlled movements experience LOS D or LOS E. Most of these movements with poor LOS occur at the Chipman Road and Pryor Road intersection. The recommended right-turn lanes will reduce delay throughout the intersection and change some of the LOS E movements to LOS D or better.

The existing northbound left-turn lane at the intersection of Chipman Road and Pryor Road should have ample capacity to accommodate the proposed development impact without further improvement. However, adjacent through queues may block entry to the turn lane during portions of the PM peak hour. Extending the northbound left-turn lane may be considered in a traffic study update at such time as a preliminary development plan is submitted. At this time of review, the LOS and delays associated with this intersection and movement do not demand mitigation with any northbound left-turn lane extension for the proposed development. There is ample median in place to extend the northbound left-turn lane as needed to clear the adjacent queue if and when necessary for adequate operations.

The LOS D movements reported at the intersection of O'Brien Road and Pryor Road do not have significant queuing reported. The eastbound left turn lane has queues that exceed the 150' approved condition. A recommended eastbound left turn lane with capacity of 300 feet should be provided. The site plan shows access along O'Brien Road approximately 200 feet west of Pryor Road and additional access just beyond 300 feet from Pryor Road. The closest access shown on the site plan along O'Brien Road to Pryor Road should be removed or restricted to right-in/right-out by a raised median to protect the intersection functional area and allow for adequate left-turn storage of projected queues.

Through movement queues adjacent to turn lanes at the studied signal controlled intersections may block turn lane access from time to time during the peak hours. These conditions are similar to those reported for Existing Conditions and Existing plus Approved Conditions, but are expected with more regularity. The blocked turn lanes generally still have capacity to accommodate the turning movements and perform with adequate LOS. In addition, these turn lanes (nearly all left-turns) cannot be extended beyond current storage and to the extent through queues have no influence without limiting access to adjacent intersections, if at all possible due other geometric constraints. The limitations and issues associated with existing turn lanes and dual left turns are explained in more detail under the Existing Conditions section.

No other turn lane improvements are recommended at the studied traffic signal intersections for Existing plus Approved plus Proposed Development to contain queues and achieve acceptable operations.

The individual stop controlled traffic movements at unsignalized intersections are expected to meet performance goals with exception of the intersection at Pryor Road and Shamrock Avenue. The stop controlled movements at this intersection will likely fail with excessive delay during both peak hours due to the increased traffic volume and uninterrupted traffic along Pryor Road. The intersection will likely warrant traffic signal control as outlined in the Existing plus Approved plus Proposed Development Signal Warrant subsection. The intersection would likely have LOS A and LOS B during the AM and PM peak hours, respectively, if traffic signal control were installed. Vehicle queues would also be manageable with signal control and not require additional turn lane capacity at the intersection of Pryor Road and Shamrock Avenue.

The commercial driveways proposed along O'Brien Road west of Pryor Road are shown beyond the turn lane distances, reported queues, and intersection functional areas.

The Existing plus Approved plus Proposed Development capacity analysis and queuing summary is illustrated in **Figure 10**. Detailed results may be found in **Appendix D**.

The following improvements are recommended in support of the proposed development to mitigate delay and queues in compliance with City adopted Level of Service goals for adequate transportation infrastructure:

- Northbound right-turn lane with 250' of storage plus taper along Pryor Rd. at Chipman Road
- Eastbound right-turn lane with 250' of storage plus taper along Pryor Rd. at Chipman Road
- Eastbound left-turn lane with at least 300' of storage along O'Brien Road at Pryor Road
- Remove proposed driveways along O'Brien Road within 300 feet of Pryor Road or restrict driveway access within this area to right-in/right-out with a raised median along O'Brien Road
- Traffic signal installation at the intersection of Pryor Rd. and Shamrock Ave. with interconnect to adjacent traffic signals

All other elements of access, driveway location, site circulation, etc. shown on the site plan should comply with the *Access Management Code* as depicted on the application.

FIGURE 10

Existing Plus Approved Plus Proposed Development Lane Configuration and Traffic Controls

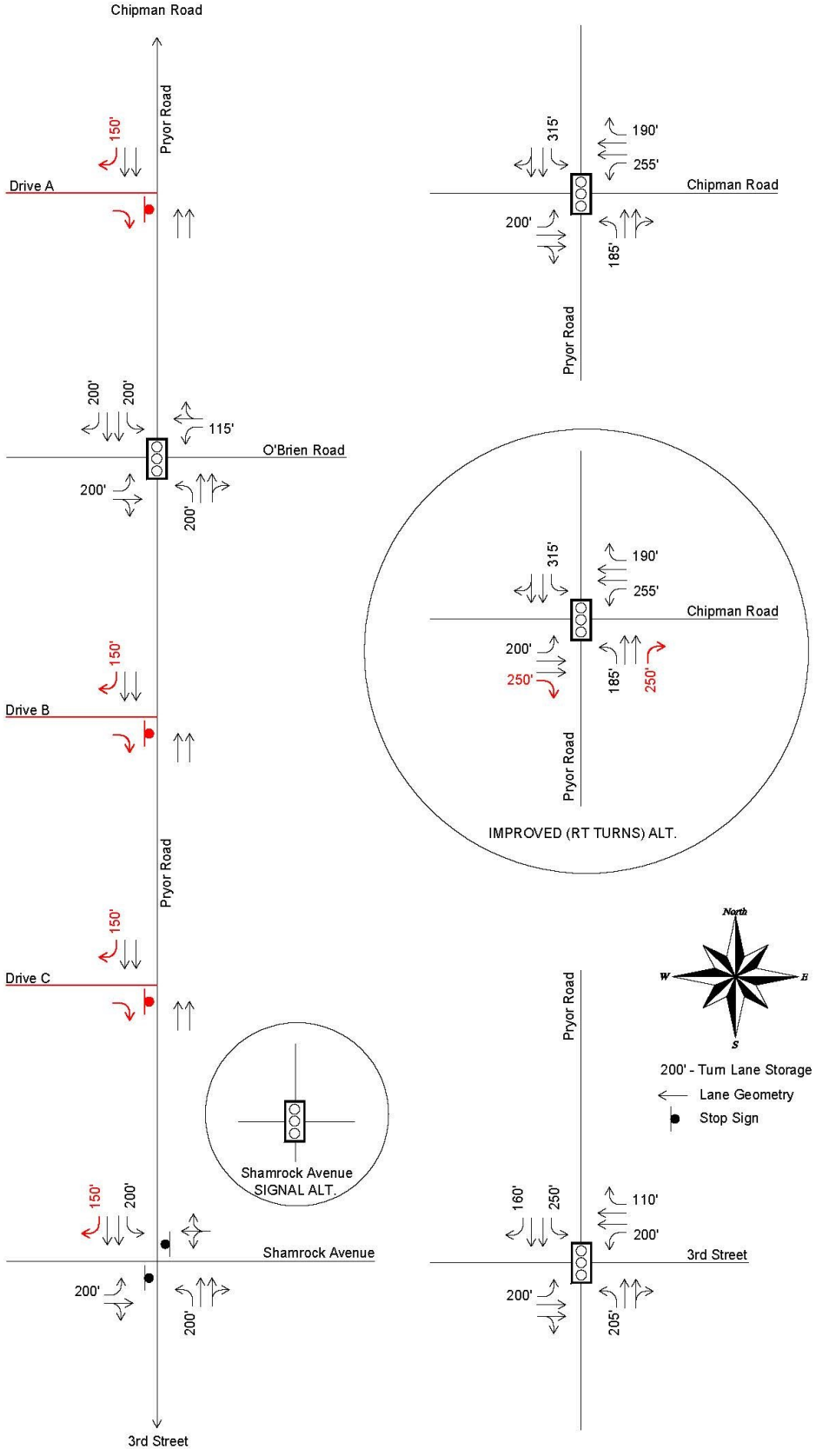
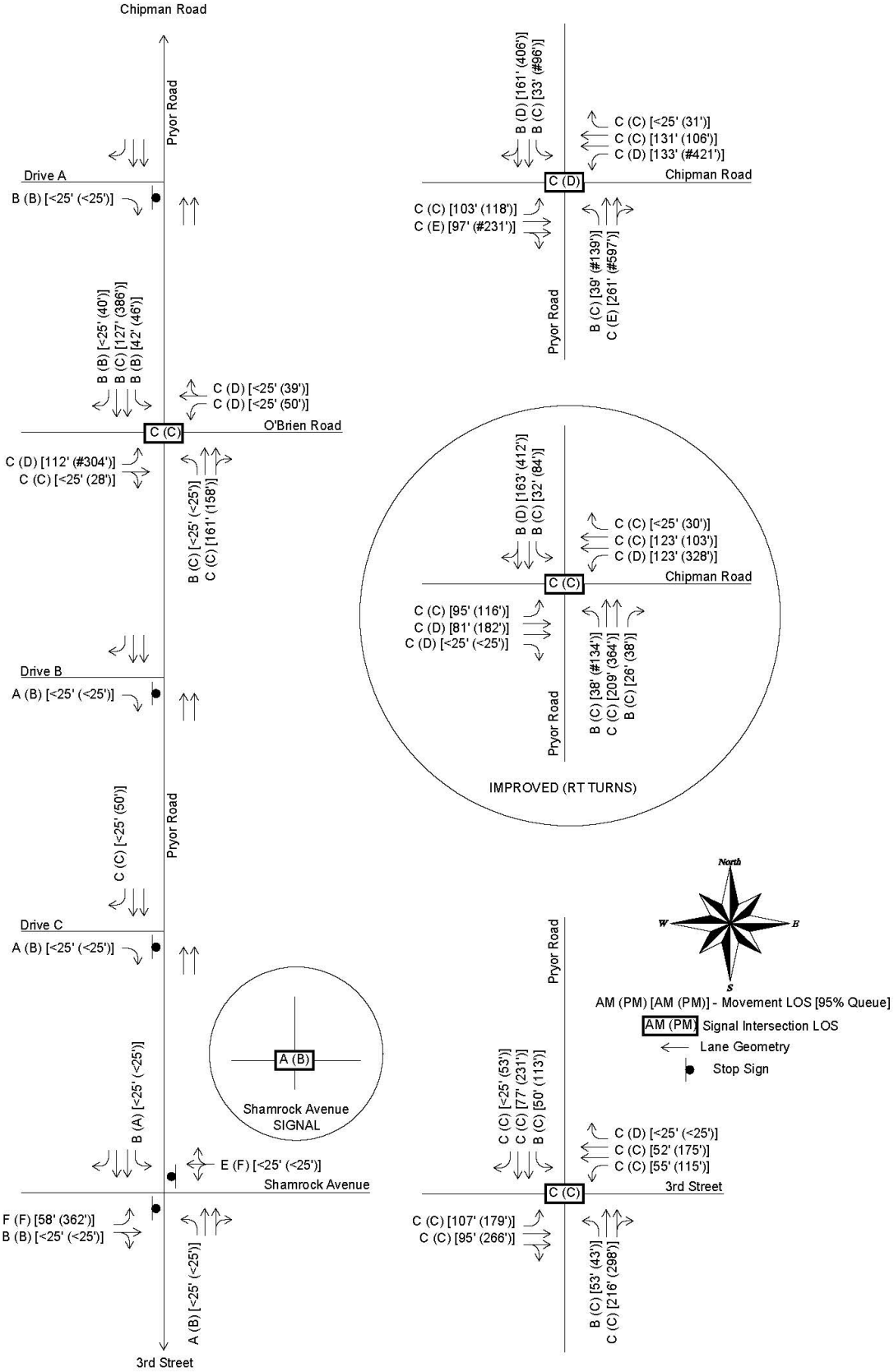


FIGURE 11

Existing Plus Approved Plus Proposed Development Level of Service/Queues



6.0 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to summarize the traffic impacts regarding the proposed West Village development located on the west side of Pryor Road between Chipman Road and 3rd Street in Lee's Summit, Missouri. Based on this evaluation, the following conclusions and recommendations are made for the study area.

Conclusions

The general findings of this traffic impact study can be summarized by a few main points:

- In general, traffic operations after development of the proposed site are expected to be acceptable with a several public improvements to mitigate the impact of development generated traffic and comply with the *Access Management Code*. Those improvements may be common to other development approved in the same vicinity (i.e. Woodside Ridge) and should be coordinated to the extent practical. The improvements are listed in the recommendations.

- The existing lane configuration of several study intersections does not currently meet the minimum turn lane criteria provided in the City of Lee's Summit *Access Management Code*. Traffic operations before and after development and in consideration of approved development were reviewed to determine if improvements should be recommended to meet minimum turn lane standards defined in the code based on safety (presence for certain roadway classes) and operations (queueing and level of service). Based on this review, additional turn lanes at the study intersections are likely to provide some operational and safety benefits; however, those improvements are not a necessity at this time, or with proposed development, outside the intersection of Chipman Road and Pryor Road due to the acceptable operations and queuing reported.

- All intersections have reported adequate level of service during both commuter peak hours in all analysis scenarios with the exception of Shamrock Avenue at Pryor Road in the AM and PM peak hours and Chipman Road and Pryor Road PM peak hour. The Shamrock Avenue intersection exhibits poor stop controlled operations on under the proposed developed conditions and may warrant traffic signal control. Without traffic signal control, side street delay incurred by site generated traffic may be excessively long, as will vehicle queues. Since traffic on Pryor Road will not be stop controlled to allow for a gap in the high traffic volume, no other mitigation will address the issue. It's possible some gaps in traffic may be created at adjacent intersections for lower side street traffic volumes. The location supports traffic signal control. A more accurate signal warrant analysis should be done at such time as a development moves from conceptual plan to preliminary plan. The intersection of Chipman Road and Pryor Road may only be improved with a northbound and eastbound right-turn lanes to adequate LOS. The northbound right-turn lane likely has significant utility conflicts. No other capacity improvements at this intersection are feasible without total reconstruction and widening of Chipman Road and Pryor Road.

Recommendations

Given the review of information, list of conclusions and intersection specific capacity and queueing analysis, the following items are recommended for the study area:

1. Construct an eastbound left-turn lane with at least 300 feet of storage (along with reconstruction of O'Brien Road) at Pryor Road and O'Brien Road. *This improvement is in part a condition of approval for another development in the immediate vicinity which requires 150 feet of storage plus taper.*

2. Construct a northbound left-turn lane with at least 200 feet of storage plus taper (maximized space) at Pryor Road and Shamrock Ave. *This improvement is a condition of approval for another development in the immediate vicinity and included in a current City Capital Improvement Project (i.e. Fire Station #3 Relocation).*

3. Construct an eastbound left-turn lane (and the extension of Shamrock Avenue west of Pryor Road having at least one thru lane in each direction) with at least 150 feet of storage plus taper at the intersection of Pryor Road and Shamrock Avenue. *This improvement is a condition of approval for another development in the immediate vicinity and included in a current City Capital Improvement Project (i.e. Fire Station #3 Relocation).*

4. Construct a southbound right-turn lane with at least 150 feet of storage plus taper along Pryor Rd. at Drive A.

5. Construct a southbound right-turn lane with at least 150 feet of storage plus taper along Pryor Rd. at Drive B.

6. Construct a southbound right-turn lane with at least 150 feet of storage plus taper along Pryor Rd. at Drive C.

7. Construct a southbound right-turn lane with at least 200 feet of storage plus taper along Pryor Rd. at O'Brien Road. *This improvement is a condition of approval for another development in the immediate vicinity.*

8. Construct a southbound right-turn lane with at least 150 feet of storage plus taper along Pryor Rd. at Shamrock Avenue.

9. Construct a northbound right-turn lane with at least 250 feet of storage plus taper along Pryor Rd. at Chipman Road.

10. Construct an eastbound right-turn lane with at least 250 feet of storage plus taper along Pryor Rd. at Chipman Road.

11. Remove proposed driveways along O'Brien Road within 300 feet of Pryor Road or restrict driveway access within this area to right-in/right-out with a raised median along O'Brien Road.

12. Traffic signal installation at the intersection of Pryor Rd. and Shamrock Ave. with interconnect to adjacent traffic signals

These improvements shall be substantially completed prior to the issuance of occupancy for any building within the proposed development except where the Drive is not associated (not built). These recommended conditions of approval shall also not apply to the development of the Fire Station unless otherwise noted below. The Fire Station requires no improvements beyond those necessary for the Existing plus Approved Development scenario based on its trip generation. Those improvements in support of the Fire Station include a northbound left-turn lane and eastbound left-turn lane (with construction of Shamrock) at the intersection of Pryor Road and Shamrock Avenue.

A subsequent traffic impact study may be conducted in association with the preliminary development plan (and shall be required for any substantial changes to the plan reviewed or time lapse) in which the proposed development and conditions of recommendation are re-assessed, updated and potentially phased.

Any improvements shared by this project and approved developments or Capital Improvements should be coordinated.

Appendix A