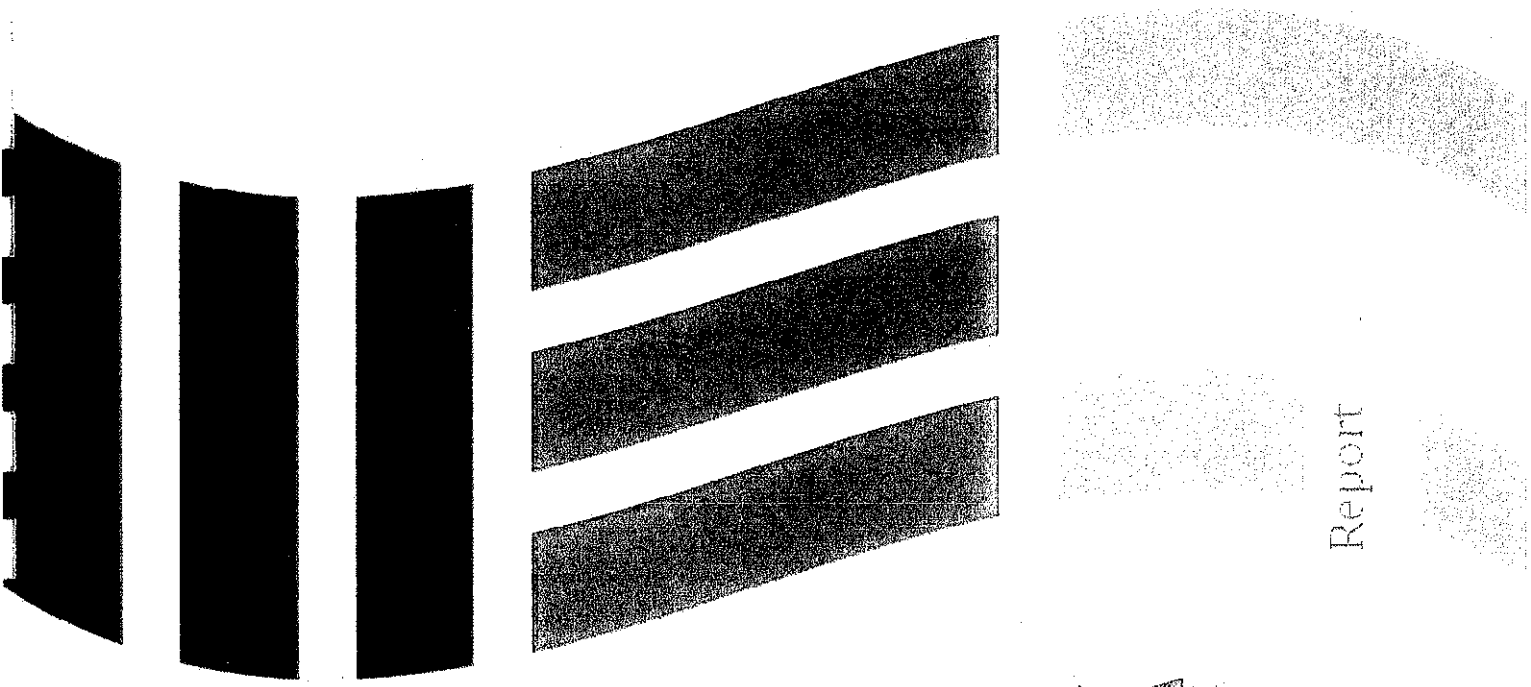
REPORT
SUMMIT ORCHARDS TRAFFIC IMPACT STUDY
CITY OF LEE'S SUMMIT
March 2016



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FINAL REPORT
SUMMIT ORCHARDS TRAFFIC IMPACT STUDY
CITY OF LEE'S SUMMIT
March 2016

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Missouri.

Lisa VanDenberg

Date: 3/29/16

LISA M. VANDENBERG, P.E.

License No. **025054**

My renewal date is **December31, 2016**

Pages or sheets covered by this seal:

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1.0 INTRODUCTION & OBJECTIVE

The purpose of this report is to document the impacts of the proposed Summit Orchards development, evaluate operations of the site intersections, and identify problems and necessary improvements to the supporting and adjacent roadway network.

Summit Orchards is a 55-acre development consisting of a mix of residential apartments, retail, service and office uses within the City of Lee's Summit, Missouri. The first phase of the development is a multi-building apartment complex equaling 318 units. The second stage is commercial and will develop over time. Land use assumptions for the commercial uses are retail shopping, sit-down restaurants, a fast-food with drive thru and a convenience store. The last phase consists of several office buildings with three of the buildings having access to Ward Road via Donovan Road and access to Chipman Road via Donovan Road. The fourth building is only accessible through two right-in, right-out driveways, one on Ward Road and the other on Tudor Road. **Figure 1** shows the location of the Summit Orchards development. **Figure 2** shows the preliminary layout of the complete site (Apartments; Commercial; and Offices).

The objective of this study is to evaluate the existing traffic conditions and traffic impacts from the proposed development. The City of Lee's Summit Access Management Code (November 2004) was referenced when applicable. This study identifies the appropriate traffic control and intersection geometrics needed to accommodate the increases in traffic due to the development. This study also discusses the trigger for when Ward Road would need widened from the existing 2-lanes to a 4-lane facility.

Tentatively, Ward Road from Tudor Road to Chipman Road would be widened in conjunction with the widening on Ward Road from Blue Parkway to Tudor Road. This widening would occur upon the completion of Summit Place. This study presents various traffic volume scenarios and whether signals or widening is needed based on other development.

Since the Missouri Innovation Campus (MIC) to the north is currently under construction, Existing Traffic Volumes are the current traffic plus the generated traffic from the completion of MIC Phase 1, a 3-story, 225,000 square foot (sf) educational building.

Both the AM and PM peak hours were analyzed for all scenarios. As the PM peak hour is predicted to have higher overall traffic volumes, only the PM peak hour was used to derive approximate ADT ranges used for the discussion regarding the widening of Ward Road.

- Existing Traffic Volumes/Conditions (includes MIC Phase 1 completion)
- Existing Plus Apartments
- Existing Plus Apartments and Commercial
- Existing Plus Apartments, Commercial and Office Buildings
- Existing Plus MIC Full Build (Phase 1 and 2) Plus Apartments
- Existing Plus MIC Full Build (Phase 1 and 2) Plus Apartments and Commercial

Figure 1 – Location Map

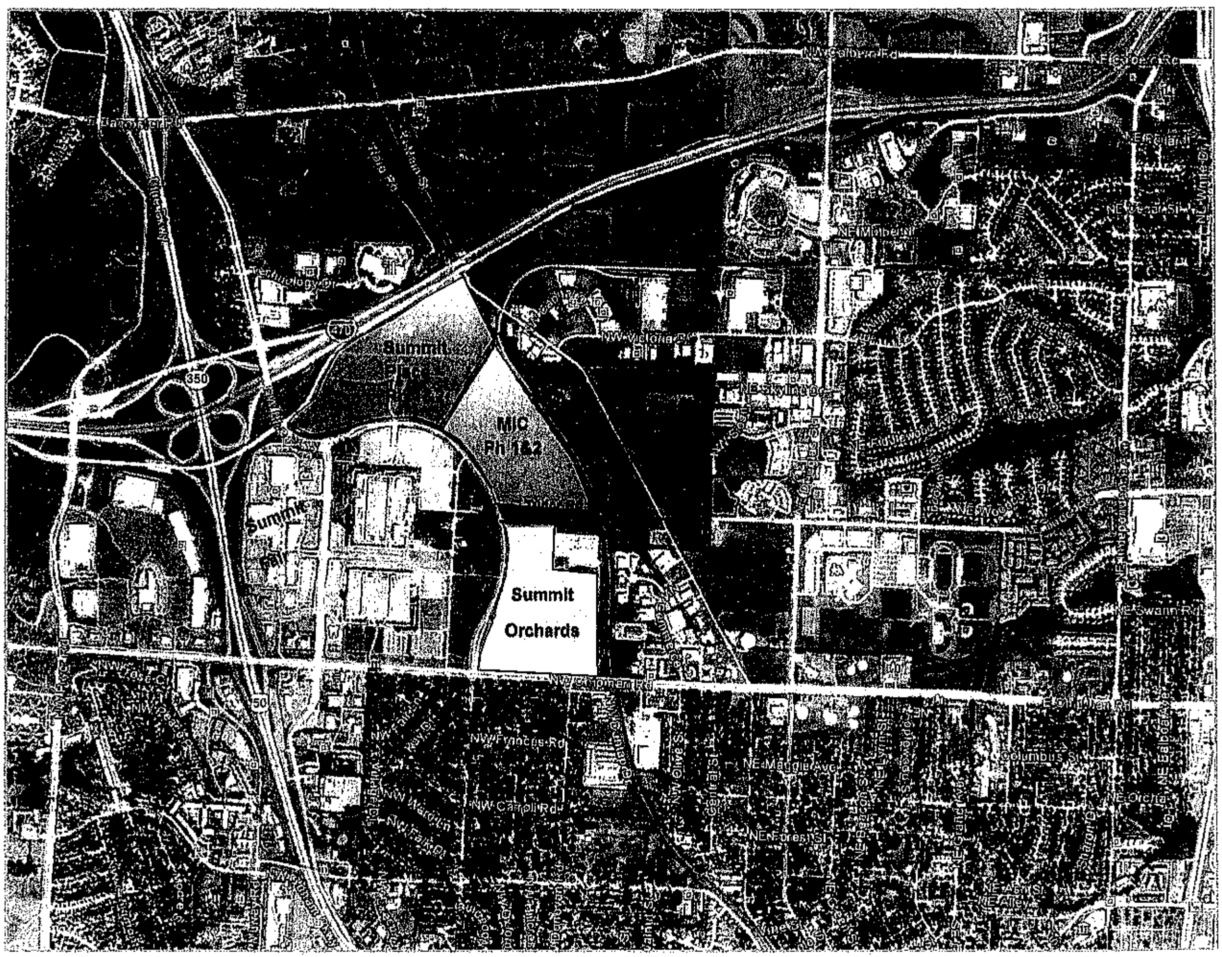
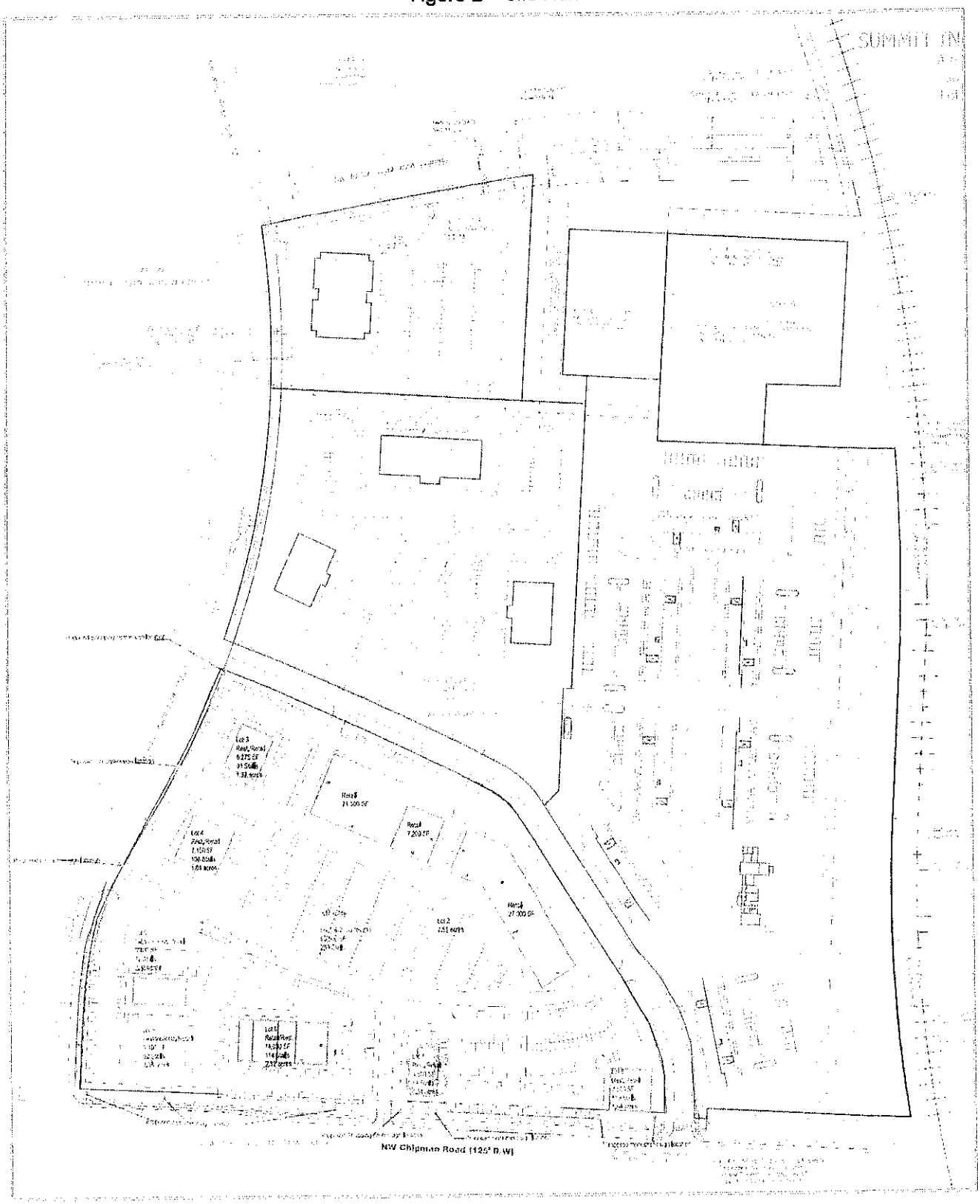


Figure 2 – Site Plan



An additional scenario of Existing Plus Full Build MIC (Phase 1 and 2) Plus Apartments Plus Summit Fair/Summit Place was reviewed for further discussion on the timing for potential signal installations and widening of Ward Road. As Summit Place and the completion of Summit Fair in itself would trigger the widening of Ward Road, analysis of these scenarios is not included in this report and was detailed in a prior study.

Intersections (existing and future) analyzed for this study include the following.

- Chipman Road and Ward Road
- Chipman Road and Donovan Road
- Ward Road and Donovan Road
- Ward Road and Tudor Road (under construction)
- Ward Road and Innovation Parkway
- Right-in, right-out (RIRO) Drive 1 and Chipman Road (constructed for Commercial phase)
- RIRO Drive 2 and Ward Road (constructed for Commercial phase)
- RIRO Drive 3 and Ward Road (constructed for Office phase)
- RIRO Drive 4 and Tudor Road (constructed for Office phase)

2.0 DESCRIPTION OF STUDY AREA

2.1 Proposed Development

The approximately 55-acre development of Summit Orchards is located east of Ward Road, south of Tudor Road, north of Chipman Road and is serviced by an extension of Donovan Road through the development. Figure 1 shows the location of the proposed and approved sites.

Part 1 consists of seven apartment buildings with 318 dwelling units. Two driveways on the Donovan extension provide service to the buildings. The Chipman Road/Donovan Road intersection is immediately adjacent to the site and would provide the most direct access. Traffic may also choose to use the Ward Road/Donovan Road intersection.

Part 2 consists of commercial businesses which will be a mix of retail shopping, restaurants, and possibly a convenience store/gas station. The Donovan extension to the north into the site will provide driveway locations for the various businesses in addition to two right-in, right-out driveways, one located on Ward Road just north of Chipman Road and the other located on Chipman Road just east of Ward Road.

Several of the commercial lots in could provide specialty retail, service-oriented or a smaller business where the business is not open in the morning hours and where there is potential for generating considerably less traffic during the PM peak hour than the ITE Land Use Code of Shopping Center. For purposes of analysis, ITE Land Use 820 Shopping Center is assumed and will provide conservative results and allow assignment of AM peak hour trips.

Part 3 is the final phase for Summit Orchards and consists of a multi-building office complex that would be accessed via Donovan Road. From there, drivers could choose to enter or exit Ward Road to the west or to use Chipman Road to the south. The single access point for the multi-building office site is nearest the Ward Road intersection.

The final building is anticipated to be an office building in the southeast corner of the Ward Road/Tudor Road intersection. The only access would be right-in, right-out, one assigned to each roadway.

Figure 2 illustrates the proposed site plan and access points.

2.2 Roadway Classifications and Characteristics

As pertains to the vicinity of the site:

Ward Road is a two-lane north/south to east/west major arterial from the intersection with Chipman Road just east of the intersection at Blue Parkway. The posted speed limit is 35 mph. In conjunction with the completion of the Summit Place development, Ward Road is proposed to be widened/expanded to a four-lane facility from the Tudor Road extension to Blue Parkway. Currently, the developer of the MIC site plans to construct the four-lane section from Tudor Road to Chipman Road when the section of Ward Road from Blue Parkway to Tudor Road is constructed.

Tudor Road is planned as a four-lane east/west divided major arterial roadway with a speed limit of 35 mph from Douglas Road to the intersection of Ward Road.

Chipman Road is a four-lane east/west divided major arterial roadway with a speed limit of 35 mph.

2.3 Study Intersection Characteristics

The intersection of Ward Road and Chipman Road is a signalized four-legged intersection. Dedicated left turn lanes are provided for all movements including dual left turn lanes for the southbound and eastbound movements. Dedicated right turn lanes are provided for the westbound and southbound movements. Pedestrian accommodations are provided along the west and south legs of the intersection and include marked crosswalks, pedestrian indications, and push buttons.

The intersection of Ward Road and Innovation Pkwy/Outerview Drive is currently under construction and is 4-legged intersection with stop control for the Innovation Parkway and Outerview Drive approaches. A dedicated right-turn lane is provided for the southbound movements. A dedicated left turn lane is provided for the southbound movement.

The construction plans for the Tudor Road extension project show the geometrics of the Ward Road intersection as a three-legged intersection with stop control on Tudor Road. Tudor Road will be a four-lane divided major arterial. Lane use configuration at the intersection provides for the two westbound lanes to end in left-turn only and right-turn only lanes. The addition of a southbound left turn lane on Ward Road at the Tudor Road intersection is planned as a part of this project. A right turn bay is not planned at this time, but should be reconsidered when Ward Road is widened to 4-lanes.

Plans for the Summit Orchard development include two full access intersections; one at Ward Road and Donovan Road and the other at Chipman Road and Donovan Road. Both locations are planned with left turn storage lanes and right turn deceleration lanes from mainline onto

Donovan Road. Donovan is planned to be a 3-lane facility to provide for left turn lanes along the road.

Two right-in, right-out drives will be constructed to provide additional access for the commercial lots. One will be on Ward Road and the other on Chipman Road.

The single stand-alone office building on the northern most part of the site will have two right-in, right-out drives as access. One will be on Ward Road and the other on Tudor Road.

3.0 DESCRIPTION OF STUDY SCENARIOS

For practical purposes of this study, the existing and proposed scenarios consider the Tudor Road extension as being completed.

Since the timeframe for construction of approved developments is unknown, several alternative evaluation scenarios have been made. The timing of the developments is an important factor as Ward Road widening improvements are planned to be constructed in concurrence with the construction of Summit Place.

The existing scenarios consider the current roadway network with existing traffic volumes plus the completion of MIC Phase 1 with an anticipated 3,000 student enrollment. The Existing Plus Apartments consists of the existing traffic volumes as described plus the completion of seven apartment buildings, totaling 318 units. The Existing Plus Apartments & Commercial consists of existing traffic plus the completion of the apartments and the full build out of the commercial retail and service portion of the development. The Existing Plus Apartments, Commercial and Offices consists of the existing traffic plus the apartments, commercial lots and full build of the office buildings.

It is possible that Phase 2 of the Missouri Innovation Campus (MIC) could be built prior to or at the same time as different pieces of Summit Orchards are constructed. Therefore, additional analysis scenarios were developed.

The Existing Plus MIC Full Build Plus Apartments consists of the completion of Phase 1 and Phase 2 of the MIC site plus the completion of the apartments from the Summit Orchard site. The Existing Plus MIC Full Build Plus Apartments Plus Commercial consists of the completion of Phase 1 and Phase 2 of the MIC site plus the completion of the apartments and commercial lots from the Summit Orchard site.

An additional scenario was developed for use in evaluating average daily traffic (ADT) levels and signal warrants used for furthering discussion on the potential timeframe for signalizations. That scenario considers that the full build out of MIC Plus the apartments in Summit Orchard Plus the completion of Summit Fair and Summit Place.

No future 20-year projection analysis was required for this project based on correspondence with City staff.

4.0 DATA COLLECTION

Turning movement counts were collected at the intersection of Chipman Road and Donovan Road during the weekday for a 24-hour period. This data was collected on Thursday, March 3rd, 2016. The weather was dry and clear and the pavement was free from snow/ice.

Based on the traffic count, the peak hours occurred from 7:15 to 8:15 AM and 5:00-6:00 PM. Count data sheets can be found in the appendices.

5.0 METHODOLOGY OF ANALYSES

5.1 Capacity Analysis

Synchro software was used to optimize and analyze signalized intersections for level of service (LOS) and operation. Stop controlled intersections were analyzed per Highway Capacity Manual (HCM) methodologies with HCM reports being generated from the models.

SimTraffic queues were reviewed and reported for individual movements where the level of service for the movement did not meet Level of Service (LOS) D or better. SimTraffic is a microsimulation program that can record the maximum back of queue observed for every two minute period. The 95th percentile queue is the average of the two-minute maximum queues plus a standard deviation. The 95th percentile queues were compared to the available storage to determine if queuing is accommodated. Each SimTraffic simulation was run 5 times. The measures of effectiveness for the five runs were averaged to develop the results.

For intersection analysis, the Highway Capacity Manual (HCM) defines LOS in terms of the average control delay at the intersection in seconds per vehicle. The results of a HCM analysis are typically presented in the form of a letter grade (A-F) that provides a qualitative estimate of the operational efficiency or effectiveness of the corridor. Much like an academic report card, LOS A represents the best range of operating conditions (i.e., motorists experiencing little delay or congestion) and LOS F represents the worst (i.e., extreme delay or severe congestion).

Table 1: Intersection Level of Service Summary

Level of Service (LOS)	**Stop Control** Average Control Delay (s/veh)	**Signal Control** Average Control Delay (s/veh)
A	≤ 10	≤ 10
B	>10 and ≤15	>10 and ≤20
C	>15 and ≤25	>20 and ≤35
D	>25 and ≤35	>35 and ≤55
E	>35 and ≤50.	>55 and ≤80.
F	>50	>80

The City of Lee's Summit has adopted an acceptable level of service for stop control and signalized intersections. The LOS should be an overall intersection LOS C or better at signal controlled intersections. Some individual movements may operate at a lower LOS. The LOS for stop controlled intersections should ideally be LOS C or better, with LOS D being acceptable.

All analysis scenarios assume Ward Road in its current condition as two-lane roadway. **Section 11.0** addresses the widening of Ward Road, its effect on operations and analysis results, and the potential timing for road widening to four lanes.

5.2 Traffic Signal Warrant Evaluation

Traffic signal warrants are typically evaluated on current traffic levels. However, the construction of a new roadway system requires evaluation of anticipated traffic levels so that engineering judgment can be applied to determine when the installation of signals is warranted.

The Manual on Uniform Traffic Control Devices (MUTCD) provides eight warrants to evaluate whether an intersection meets certain guidelines for signalization. Typically, signal warrants are based on a complete review of these warrants using information including hourly volumes throughout the day, pedestrian counts, accident experience, and traffic progression. One of the prime warrants, the eight-hour vehicular volume, Warrant 1 is typically met for a minimum of eight hours throughout the day. In the absence of such data, and for preliminary screening of potential traffic signal, the Peak Hour Warrant (Warrant 3) from the MUTCD was applied.

Typically Warrant 3 is applied only in unusual cases, such as, manufacturing plants or industrial complexes where a large number of vehicles are discharged over a short amount of time. In this case, Warrant 3 provides a useful screening tool for traffic signal warrant evaluation.

6.0 EXISTING TRAFFIC CONDITIONS

For comparison purposes, an existing conditions analysis was performed using existing traffic volumes for the study intersections. **Figure 3** shows the existing traffic volumes that were used in the existing conditions analysis. These volumes take into account traffic from the completion of Phase 1 on the Missouri Innovation Campus. Raw traffic count data can be found in the appendices. **Section 3** details the roadway classifications and intersection geometry for the existing network. Capacity analysis follows the methodology as outlined in **Section 5**. **Table 2** shows the results for the existing traffic signals. **Table 3** shows the results for the stop controlled intersections.

Table 2: Existing Signalized Intersection LOS (delay in seconds)

Intersection	AM Peak	PM Peak
Ward Road and Chipman Road	B (16.3)	B (17.5)

Table 3: Existing Stop Controlled LOS (delay in seconds)

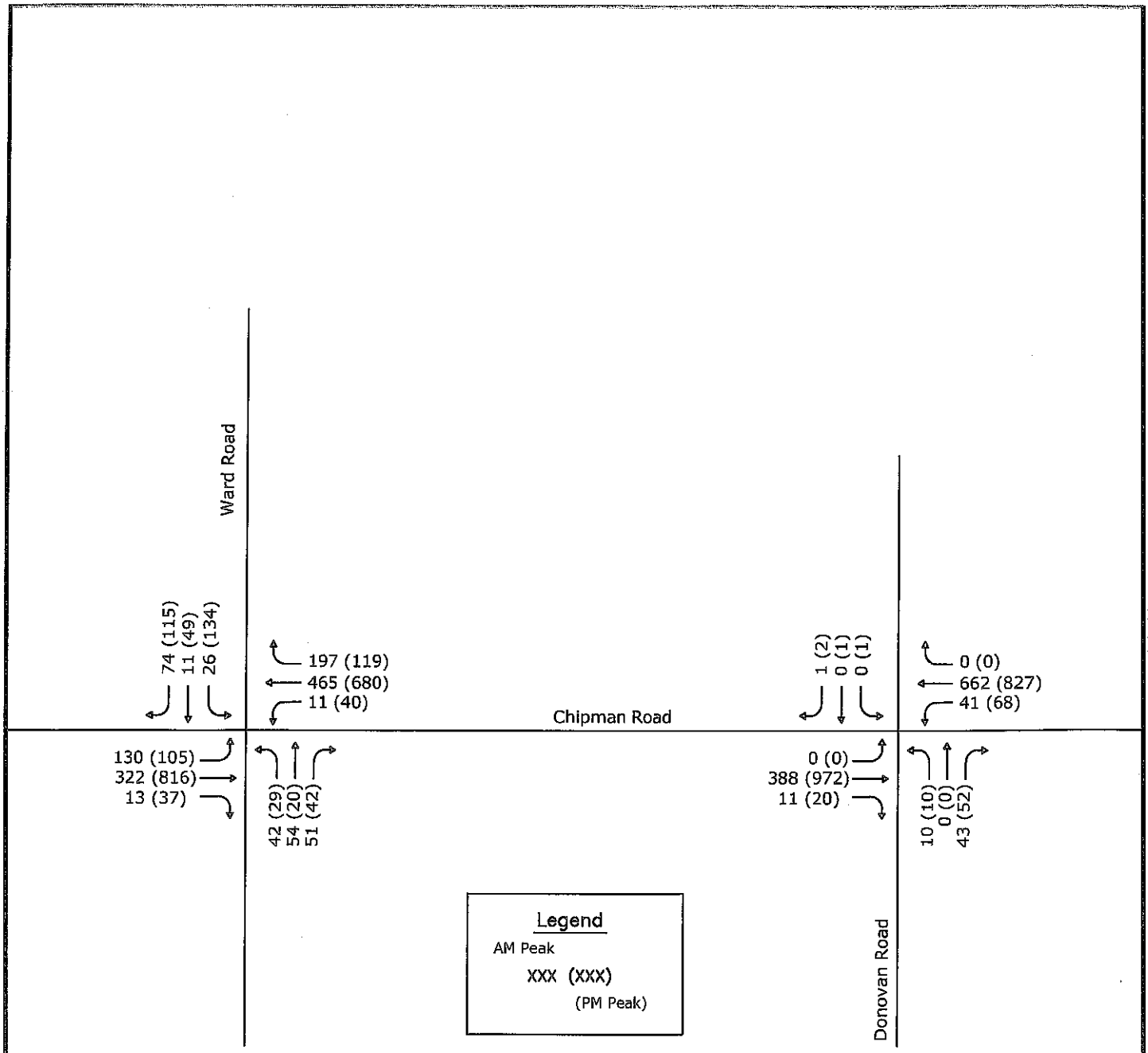
Intersection	AM Peak	PM Peak
Chipman Road and Donovan Road	C (16.2)	E (46.1)

For stop controlled intersections, the reported LOS (delay) represents the sidestreet approach with the worst level of service. The analysis shows that the signalized intersection at Ward

Road and Chipman is operating acceptably. This signal operates on an adaptive signal system. This type of system looks at "green tunnels" to anticipate the arrival of platooned vehicles instead of operating on the standard cycle length based system of coordination. In order to make comparisons between scenarios, a standard cycle length was established. This established cycle length was obtained by modeling each of the scenarios and then choosing the lowest cycle length that would accommodate each traffic volume scenario. This cycle length, 100 seconds, was used for each of the scenarios and only splits were optimized.

The left turn queues were reviewed for the Ward/Chipman intersection. All queues are contained in the turn lane storage bays and do not impede through traffic.

The intersection of Chipman Road and Donovan Road is not operating within the City's established guidelines. LOS E is experienced for the southbound movement, but the volume is only one vehicle per hour (vph), so the operation is acceptable. Northbound Donovan experiences LOS D of 28.9 seconds.



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2016 Existing Base (Existing Plus MIC Phase 1)
Summit Orchards
Traffic Impact Study
Lee's Summit, MO

NORTH

FIGURE 3
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7.0 EXISTING PLUS APARTMENTS

7.1 Trip Generation, Distribution, and Projected Volumes

As stated in the Existing Conditions scenario, existing traffic volumes includes traffic from the completion of Phase 1 of the MIC site. **Table 4** shows the trip generation of the apartments from the Summit Orchards development. Concurrence on trip generation, distribution, and projected volumes for this scenario and following scenarios were reviewed by City staff prior to running any analysis.

Table 4: Apartments, Summit Orchards, Trip Generation

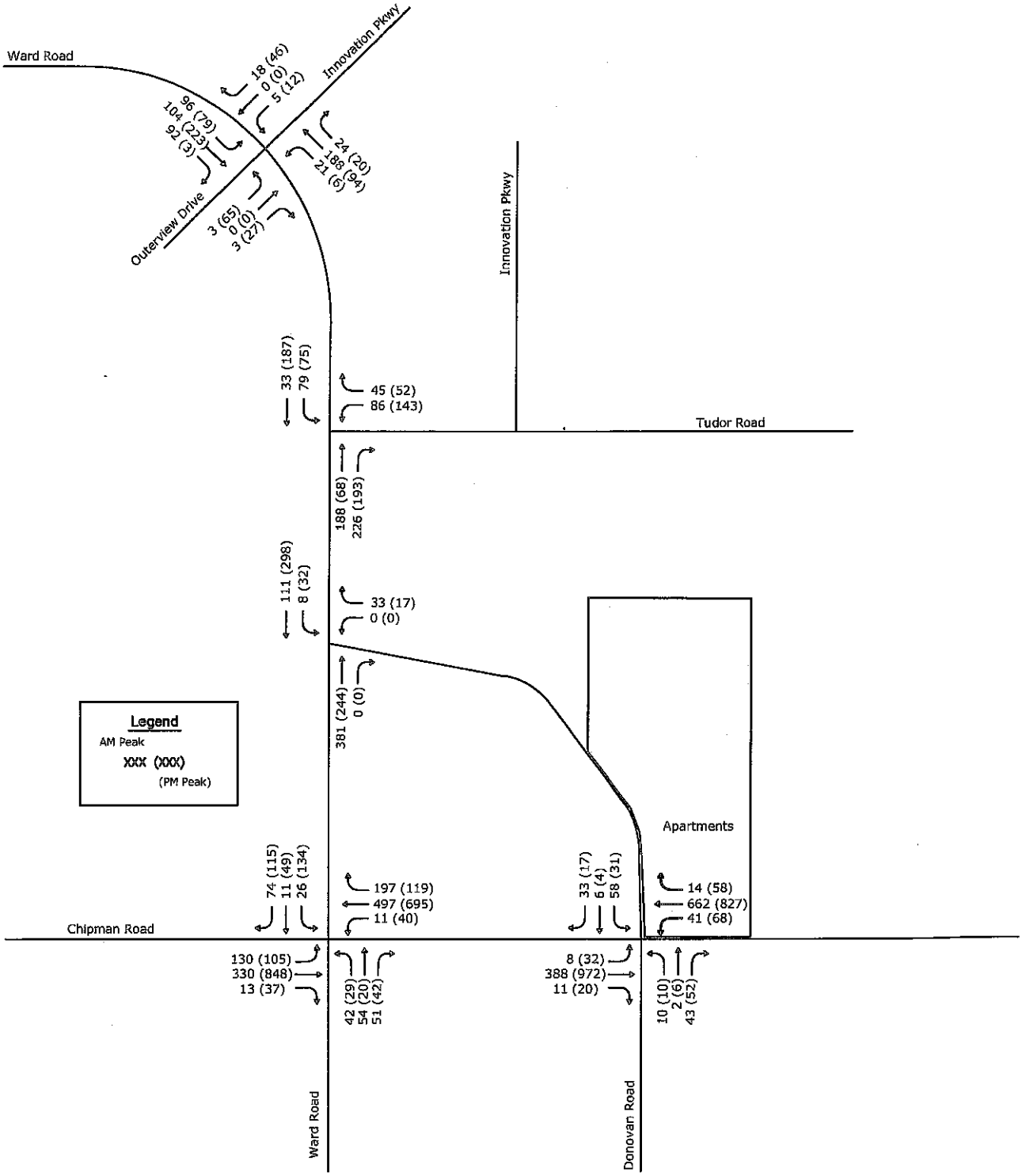
Phase 1 (Summit Orchards)				AM Peak					PM Peak				
Code	Use	Unit of Measure	Number	Avg Rate or Eq.	Enter		Exit		Avg Rate or Eq.	Enter		Exit	
220	Apartments	dwelling units	318	0.51	20%	32	80%	130	0.62	65%	128	35%	69
	Trip Ends					**32**		**130**			**128**		**69**

Trip distribution generally follows the accepted regional distribution below. There is some exception to specific lots on the site because of their driveway locations and logical path of travel.

Trip distribution assumes:

- 25% to/from the north via Ward Road/I-470 area;
- 30% to/from the east Tudor/Douglas area;
- 45% to/from Ward/Chipman Road.

Trip assignments for the Apartments are contained in the appendices. The projected volumes for Existing Plus Apartments are shown in **Figure 4**.



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Projected Volumes
Apartments, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

NORTH

FIGURE 4
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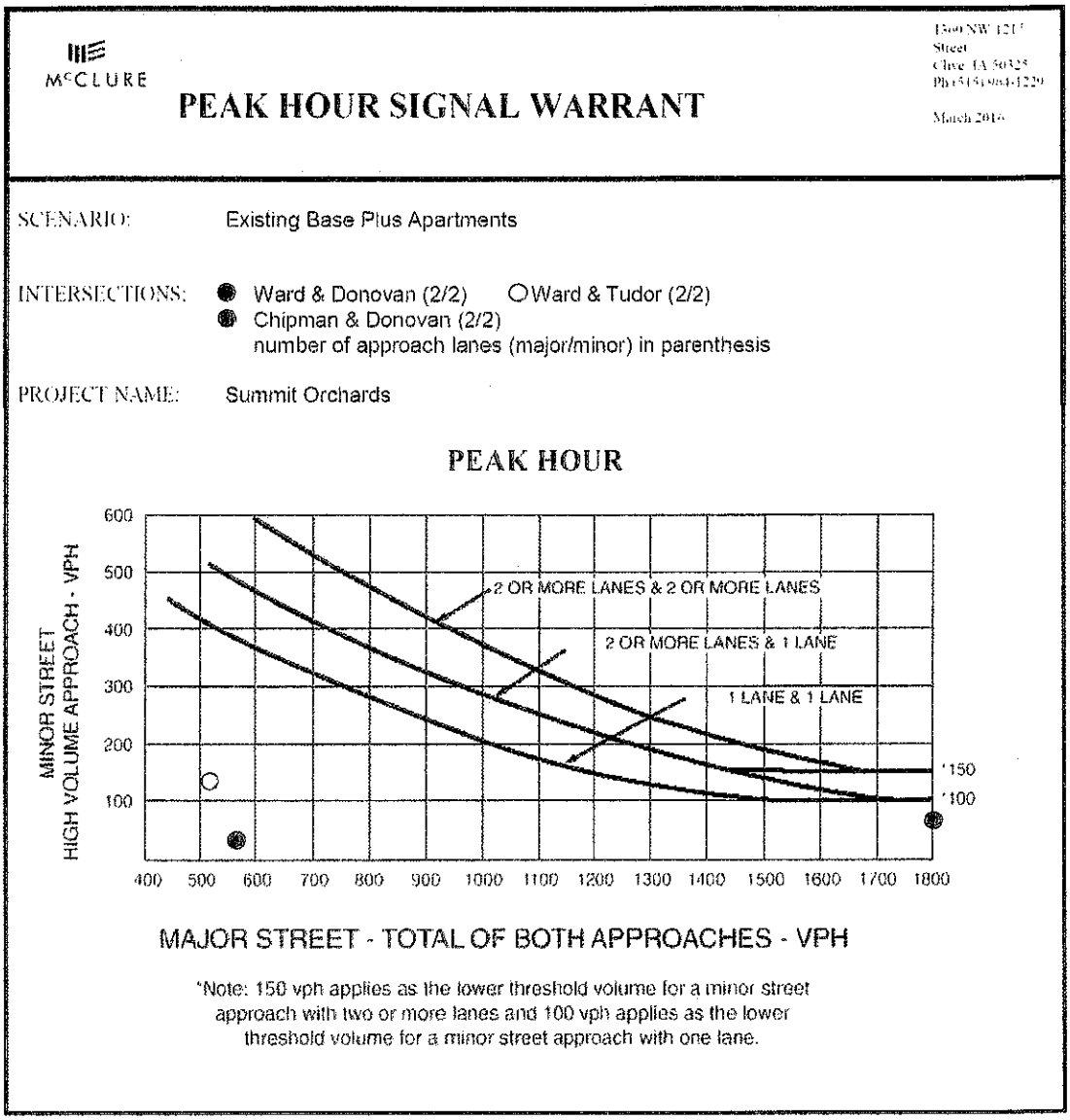
7.2 Signal Warrant Analysis

Section 5.2 describes the signal warrant evaluations and how these were conducted. The usefulness of the Peak Hour Warrant (Warrant 3) as a screening tool was discussed.

Based on Warrant 3, none of the evaluated intersections satisfy the peak hour criteria. **Figure 5** shows the graphic representation of the Peak Hour Warrant.

Figure 5 –Apartments – Peak Hour Warrant



7.3 Capacity Analysis

Capacity analysis follows the methodology as outlined in Section 5. **Table 5** shows the results for the signalized study intersections. For the signalized intersection analysis, the same cycle lengths and phases were used for each scenario without modifications; however, individual timing splits were optimized.

Table 5: Existing Plus Apartments, Signalized Intersection LOS (delay in seconds)

Intersection	AM Peak	PM Peak
Ward Road and Chipman Road	B (16.2)	B (18.0)

Table 6 shows the results for the stop controlled intersections. Geometry at the Ward Road and Tudor Road intersection includes a southbound left turn bay as being constructed as part of the Tudor Road extension project.

Table 6: Existing Plus Apartments, Stop Controlled LOS (delay in seconds)

Intersection	AM Peak	PM Peak	Movement Notes (LOS E or poorer denoted)
Chipman Road and Donovan Road	E (39.4)	F (210.1)	SBL (AM 58 vph; PM 31 vph)
Ward Road and Donovan Road	B (11.0)	A (9.8)	
Ward Road and Tudor Road	B (14.6)	C (16.5)	
Ward Road and Innovation Pkwy	B (14.9)	B (14.8)	

Similar to the Existing Traffic Volumes analysis, this analysis shows that the signalized intersection at Ward Road and Chipman is operating at a desired level of service.

For unsignalized (stop controlled) study intersections, the Chipman Road and Donovan Road intersection would operate poorly, particularly during the PM peak hour when LOS F would be expected. The number of southbound left exiting vehicles is anticipated to be 31 vph that would experience difficulty exiting the apartment site. Alternately, vehicles could exit at the Ward/Donovan intersection during difficult peak periods.

7.4 Queuing Analysis (using SimTraffic)

Because a poor level of service is anticipated at Chipman and Donovan during the peak hours, queuing was also analyzed to assist in determining the extent of the impact. Queuing for the southbound left on Donovan at Chipman would be 63 feet during the AM peak and 121 feet during the PM peak. This corresponds to roughly 3 cars in the morning and 5-6 in the evening peak.

7.5 Turn Lanes Assessment

The Lee's Summit *Access Management Code* provides guidance on when to install left turn lanes. The recommended left turn bay length (not including taper) at an arterial street intersection with another arterial street is 250 feet. The recommended left turn bay length (not including taper) at an arterial street intersection when intersecting another roadway/drive that is not an arterial is 200 feet. Queues were reviewed to assess whether the turn bay length per the *Access Management Code* was sufficient.

The *Access Management Code* also provides guidance regarding the recommendations of right turn lanes. Right turn lanes are recommended along arterial roadways at each intersecting street or driveway location. The recommended turn bay length (not including taper) at an arterial street intersecting another arterial street is 250 feet. The recommended turn bay length (not including taper) along an arterial is 150 feet when intersecting any roadway/drive other than an arterial roadway. The following improvements are recommended.

Ward Road and Donovan Road:
A southbound left turn lane and northbound right turn lane are planned as a part of the intersection construction. Queues are small, less than 45 feet in all cases and can be contained in the turn lanes as planned.

Chipman Road and Donovan Road:
Left turn lanes from Chipman onto Donovan already exist but are very short. It is assumed that the eastbound left turn will be lengthened to the minimum required 200 feet and will be made longer if queuing results from the simulation show that it needs to be extended. Although not shown in the latest site plan exhibit, it is assumed that a minimum 150-foot right turn deceleration lane will be required (per the *Access Management Code*) for the westbound direction.

7.6 Existing Plus Apartments Recommendations

Based on level of service, delay, queuing, auxiliary turn lane assessment, and signal warrant evaluations, the only improvement recommended would be:

- left and right turn lanes from Ward Road onto Donovan Road
- left and right turn lanes from Chipman Road onto Donovan Road

7.7 Donovan Road and Driveway Throat Length

Donovan Road is proposed to be a 3-lane facility throughout the length of the development. The third lane allows for the development of a left turn bay at access points, thereby creating a two-lane approach with two outbound lanes and one in-bound lane at major intersections. The analysis shows this to be a sufficient lane arrangement for the access intersections. Allowable access locations and type of access (full or partial) have already been discussed with the city and determinations made for the access points along Ward Road and Chipman Road.

The Lee's Summit Access Management Code was referenced to determine the recommended minimum throat lengths for the proposed drive locations. The following guidelines are from the *Access Management Code*:

- All driveways shall provide at least 100 feet of throat length adjacent to arterial streets.
- Driveways serving between 100 and 400 vehicles in the peak hour shall provide at least 125 feet of throat length.
- If more than 400 vehicles per hour are serviced during the peak hour a transportation impact study should recommend throat length.

As measured from the edge of pavement of the Ward/Donovan intersection to the edge of the first driveway on Donovan, the distance is 265 feet which exceeds the guideline.

As measured from the edge of the pavement of the Chipman/Donovan intersection to the edge of the first driveway north of the intersection, the distance is 340 feet, which exceeds the guidelines and allows for queuing during the peak periods.

Internal to the site, driveway alignment is good and spacing between driveways is greater than 250 feet between all locations.

8.0 EXISTING PLUS APARTMENTS & COMMERCIAL

8.1 Trip Generation, Distribution, and Projected Volumes

The Existing Plus Apartments Plus Commercial considers the completion of the retail shopping, restaurants and convenience store in addition to the completed apartment buildings. This would involve all the commercial section being built out and the two right-in, right-out entrances constructed.

The general retail use buildings have been assigned ITE Code 820 Shopping Center for purposes of a conservative analysis.

Table 7 shows the trip generation for the Commercial part of the development.

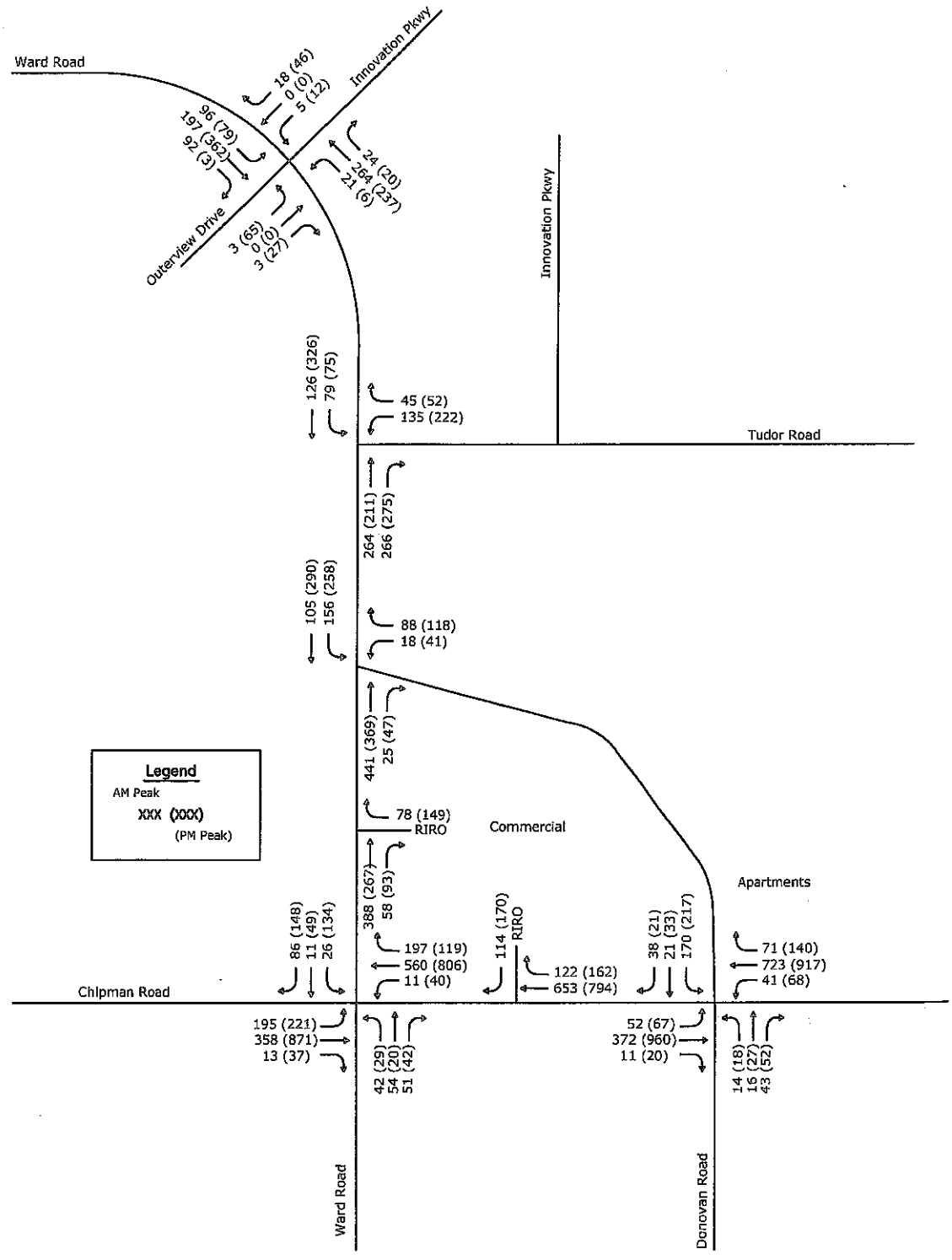
Table 7: Commercial Trip Generation

Phase 2 (Summit Orchards)				AM Peak					PM Peak					Pass-By		Pass-By AM Peak		Pass-By PM Peak	
Code	Use	Unit of Measure	Number	Avg Rate or Eq.	Enter		Exit		Avg Rate or Eq.	Enter		Exit		AM Peak	PM Peak	Enter	Exit	Enter	Exit
820	Shopping Center (Lot 1)	GFA (1000sf)	28.5	Eq.	62%	45	38%	28	Eq.	48%	124	52%	134						
820	Shopping Center (Lot 2)	GFA (1000sf)	27	Eq.	62%	43	38%	27	Eq.	44%	110	56%	140						
932	High-turnover (Sit-down) Restaurant (Lot 3)	GFA (1000sf)	6.3	10.81	55%	37	45%	31	9.85	60%	37	40%	25						
932	High-turnover (Sit-down) Restaurant (Lot 4)	GFA (1000sf)	7.2	10.81	55%	43	45%	35	9.85	60%	42	40%	28						
945	Gasoline/Serv. Station w/Conv. Mkt. (Lot 5)	pump stations	24	10.16	50%	122	50%	122	13.51	50%	162	50%	162	50%	50%	61	61	81	81
820	Shopping Center (Lot 6)	GFA (1000sf)	14	0.96	62%	29	38%	18	3.71	44%	71	56%	90						
934	Fast-food with Drive Thru (Lot 7)	GFA (1000sf)	4.5	45.42	51%	104	49%	100	32.65	52%	76	48%	71	35%	35%	36	36	27	25
932	High-turnover (Sit-down) Restaurant (Lot 8)	GFA (1000sf)	7.5	10.81	55%	45	45%	36	9.85	60%	44	40%	30						
	Trip Ends					**468**		**396**			**666**		**679**						
	Pass-By Trips					97		96			108		106						
	New Trips					371		300			559		573						

820 Shopping Center - These are likely to be Specialty Retail or daytime use (sub shop for example) that do not have morning peak hour traffic, however to be conservative and to assign AM peak values, they are assumed as Shopping Center.

Trip Generation for the AM Peak hour is substantially less than the PM peak hour; 864 trip ends in the AM peak hour versus 1,345 PM peak trip ends. In reviewing prior traffic studies, other planned developments along Ward Road generate considerably less traffic during the AM peak hour confirming the PM peak hour to be the critical weekday analysis period. Regardless, the AM peak hour is assessed in further scenarios for peak hour traffic conditions regarding potential infrastructure improvements, but is not critical in the determinations.

Similar trip distribution as was used for the Apartments trip distribution as was used for the Commercial trips. When distributing trips, the lots were broken out into different trip patterns based on location to the various entrances. Trip assignments for the Commercial trips are contained in the appendices. Projected volumes for the combined Existing Plus Apartments & Commercial are shown in Figure 6.



McCLURE™ building strong	Projected Volumes Apartments & Commercial, Summit Orchards Traffic Impact Study Lee's Summit, MO	NORTH	FIGURE 6 Page - 18

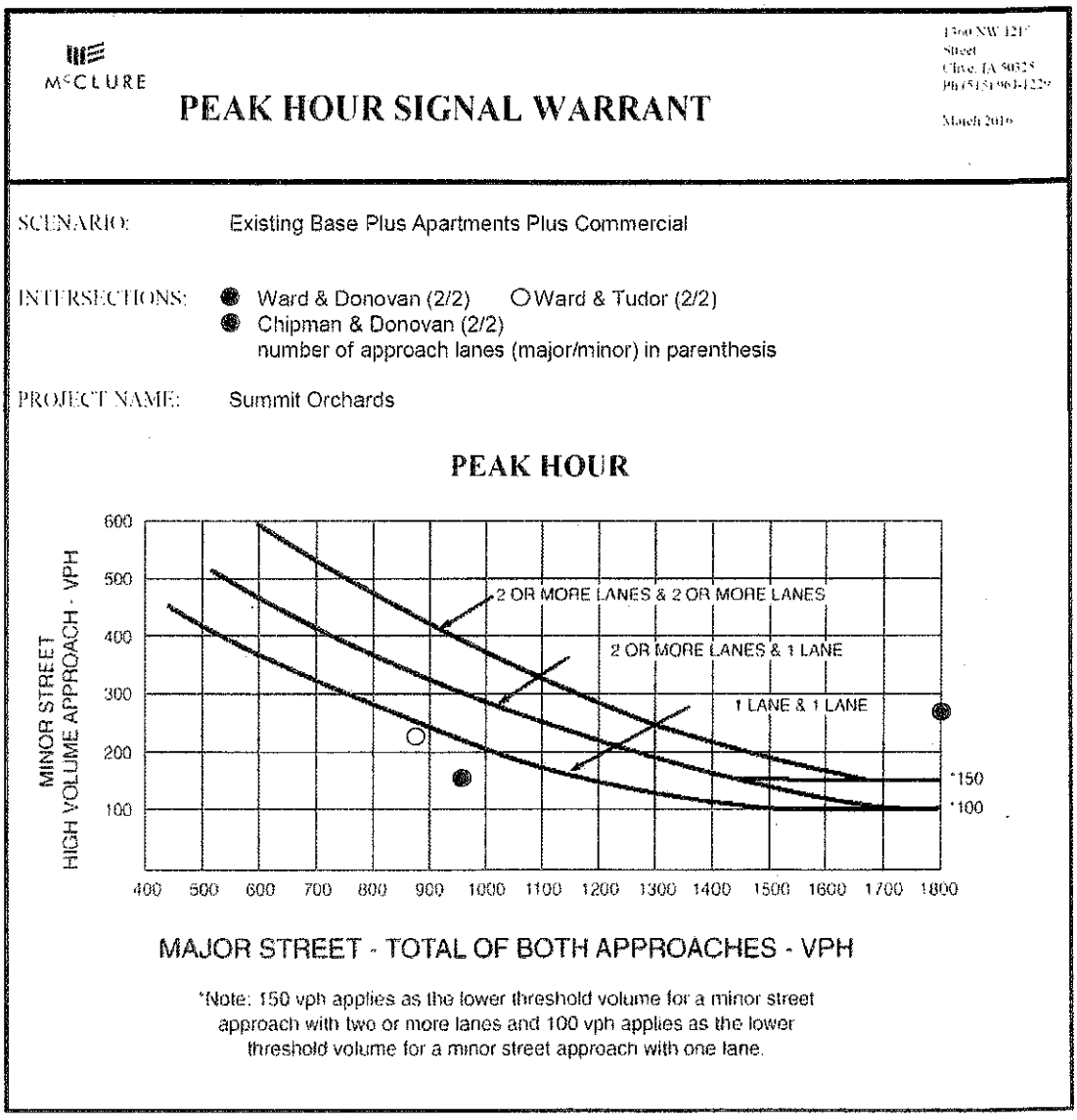
8.2 Signal Warrant Analysis

Section 5.2 describes the signal warrant evaluations and how these were conducted. The usefulness of the Peak Hour Warrant (Warrant 3) as a screening tool was discussed.

Based on Warrant 3, the intersection of Chipman Road and Donovan Road should be signalized.

Figure 7 shows the graphic representation of the Peak Hour Warrant.

Figure 7 –Apartments & Commercial – Peak Hour Warrant



8.3 Capacity Analysis

Capacity analysis follows the methodology as outlined in Section 5. **Table 8** shows the results for the signalized study intersections. For the signalized intersection analysis, the same cycle lengths and phases were used for each scenario without modifications; however, individual timing splits were optimized.

Table 8: Existing Plus Apartments & Commercial
Signalized Intersection LOS (delay in seconds)

Intersection	AM Peak	PM Peak
Ward Road and Chipman Road	B (18.8)	B (17.1)
Chipman Road and Donovan Road	B (15.4)	B (15.2)

Table 9 shows the results for the stop controlled intersections. Geometry at the Ward Road and Tudor Road intersection includes a southbound left turn bay as being constructed as part of the Tudor Road extension project.

Table 9: Existing Plus Apartments & Commercial
Stop Controlled LOS (delay in seconds)

Intersection	AM Peak	PM Peak	Movement Notes (LOS E or poorer denoted)
Chipman Road and Drive 1 RIRO	B (12.9)	C (16.3)	
Ward Road and Drive 2 RIRO	B (10.3)	B (10.5)	
Ward Road and Donovan Road	C (20.6)	E (42.3)	WBL (AM=18vph; PM=41vph)
Ward Road and Tudor Road	C (22.4)	F (60.0)	WBL (AM=135vph; PM=222vph)
Ward Road and Innovation Pkwy	C (18.4)	C (23.1)	

Similar to the Existing Traffic Volumes analysis, this analysis shows that the signalized intersection at Ward Road and Chipman is operating at a desired level of service. The intersection of Chipman Road and Donovan Road would operate well with signal control.

For unsignalized (stop controlled) study intersections, the Ward Road and Donovan Road intersection would operate poorly, particularly during the PM peak hour when LOS E would be expected. The number of westbound left exiting vehicles is anticipated to be 41 vph that would experience difficulty. Alternately, vehicles could exit at the Chipman/Donovan intersection or the RIRO drive on Ward Road during difficult peak periods.

The intersection at Ward Road and Tudor Road, could operate at LOS F during the PM peak hour, based on the HCM analysis (HCM 2010 methodology). The HCM analysis shows that the westbound left turn could experience 60.0 seconds of delay during the PM peak hour. A traffic signal would improve operations, but would not yet be warranted based on volumes.

8.4 Queuing Analysis (using SimTraffic)

Assuming the intersection of Ward Road and Tudor Road remains unsignalized, the westbound left turn queue could approach 172 feet (95th percentile queue). The average queue during this time is 95 feet with a maximum queue observed during the simulation being 219 feet. A 172-foot queue equates to about 8 cars. The distance between this intersection and the Innovation Parkway intersection to the east is approximately 475 feet. The SimTraffic analysis show that this amount of queuing would not impact the operation of the Tudor Road and Innovation Parkway intersection.

For a 2-lane approach on the major street and a 1-lane approach on the minor street, Warrant 1, Condition A calls for a total volume greater than 600 vph on the major street (both approaches) and 150 vph on the minor street approach (one approach). Warrant 1, Condition B calls for a total volume greater than 900 vph on the major street (both approaches) and 75 vph on the minor street approach (one approach). Under the Phase 2 Commercial scenario of 735 vph AM Peak (887 vph PM Peak) on Ward Road and 135 vph AM Peak (222 vph PM Peak) on Tudor Road for warrant volumes, it is unlikely that either condition would be met for eight hours under actual traffic conditions.

8.5 Turn Lane Assessment

The recommendation for left turn lanes is the same here as for the Existing Plus Apartments scenario. The following improvements are recommended.

Ward Road and Donovan Road:

A southbound left turn lane and northbound right turn lane are planned as a part of the intersection construction. Queues are small, less than 100 feet in all cases and can be contained in the turn lanes as planned.

Chipman Road and Donovan Road:

Left turn lanes from Chipman onto Donovan already exist but are very short. It is assumed that the eastbound left turn will be lengthened to the minimum required 200 feet. The expected queues can be easily contained within the 200 feet. Although not shown in the latest site plan exhibit, it is assumed that a minimum 150-foot right turn deceleration lane will be required (per the *Access Management Code*) for the westbound direction.

8.6 Existing Plus Apartments & Commercial Recommendations

Based on level of service, delay, queuing, auxiliary turn lane assessment, and signal warrant evaluations, the recommended improvements would be:

- Traffic signal at Chipman Road and Donovan Road
- Left and right turn lanes from Ward Road onto Donovan Road
- Left and right turn lanes from Chipman Road onto Donovan Road

9.0 EXISTING PLUS APARTMENTS & COMMERCIAL & OFFICES

9.1 Trip Generation, Distribution, and Projected Volumes

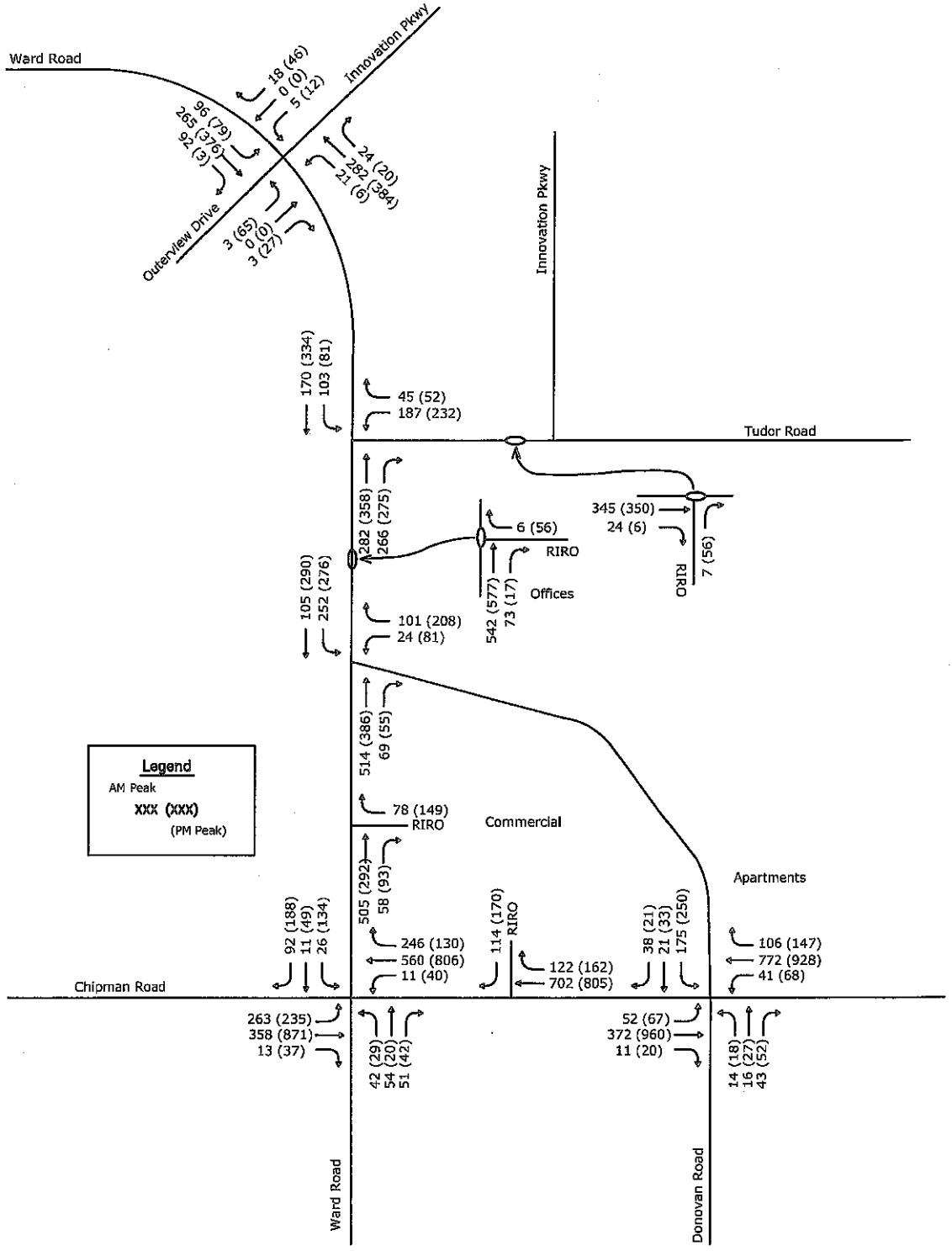
The Existing Plus Apartments & Commercial & Offices considers the completion of the office buildings in addition to the retail shopping, restaurants, convenience store and apartment buildings. This would involve full build out of the entire Summit Orchards development.

Table 10 shows the trip generation for the Offices.

Table 10: Offices Trip Generation

Phase 3 (Summit Orchards)				AM Peak					PM Peak				
Code	Use	Unit of Measure	Number	Avg Rate or Eq.	Enter		Exit		Avg Rate or Eq.	Enter		Exit	
710	General Office Building	GFA (1000sf)	105	Eq.	88%	175	12%	24	Eq.	17%	33	83%	163
710	General Office Building	GFA (1000sf)	50	Eq.	88%	97	12%	13	Eq.	17%	23	83%	112
	Trip Ends					**272**		**37**			**56**		**274**

Keeping with the regional distribution, similar trip distribution was used in this phase as in the other two phases. When distributing trips, the buildings were assigned different trip patterns based on based on their available accesses. Trip assignments for Phase 3 Offices are contained in the appendices. Projected volumes for the combined Existing Plus Apartments & Commercial & Offices are shown in **Figure 8**.



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Projected Volumes
Apartments, Commercial, Offices, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

NORTH

FIGURE 8
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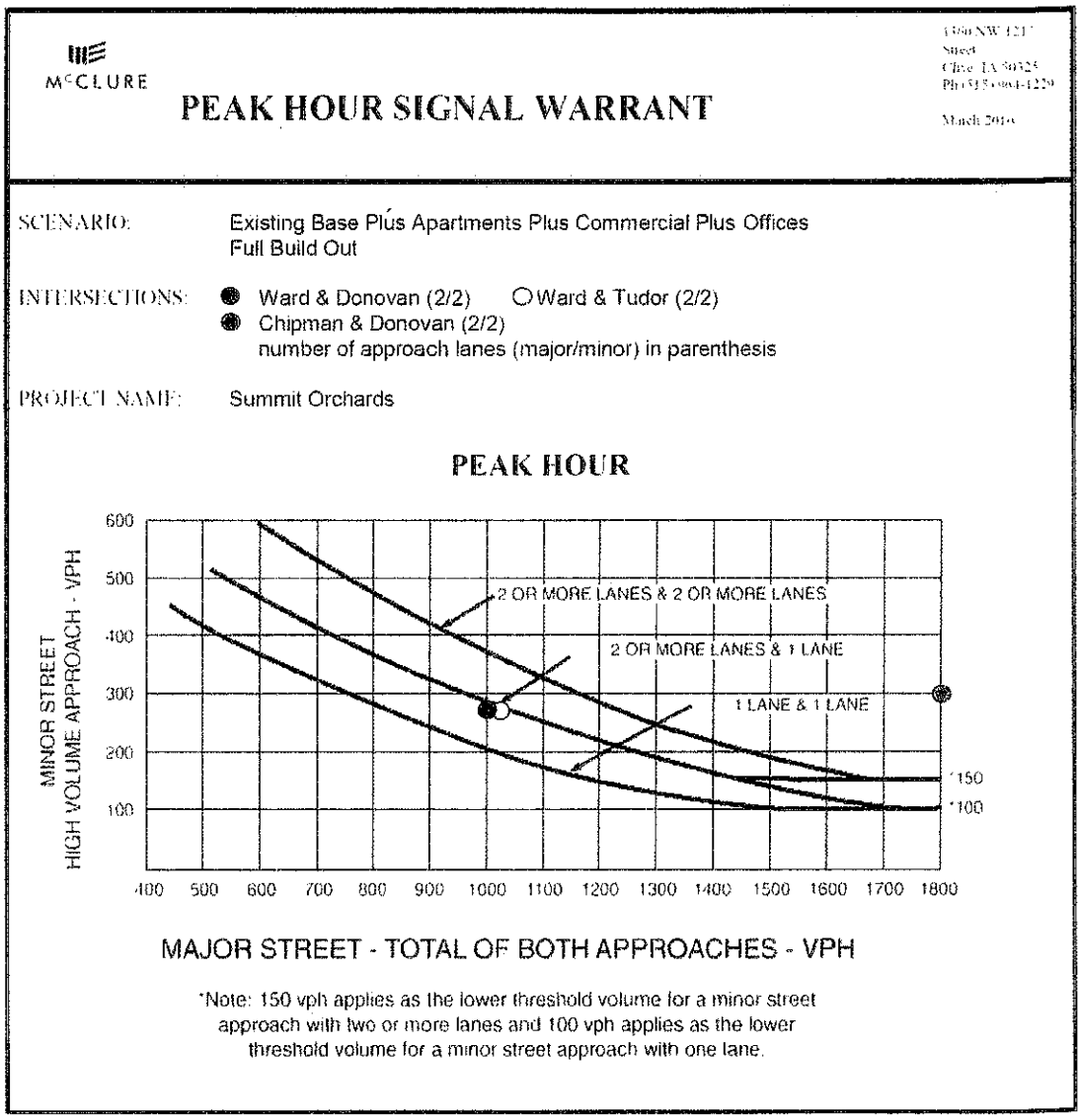
9.2 Signal Warrant Analysis

Section 5.2 describes the signal warrant evaluations and how these were conducted. The usefulness of the Peak Hour Warrant (Warrant 3) as a screening tool was discussed.

Based on Warrant 3, the intersection of Chipman Road and Donovan Road should be signalized. Regarding the intersection of Ward and Tudor as well as the intersection of Ward and Donovan, projected volumes increase enough to warrant concern. Traffic volumes and warrant justification should be monitored as individual lots develop to determine if volumes would merit installation of a traffic signal. Minor street westbound right turns were included in this scenario's evaluation because through volumes on Ward are increasing enough that there may no longer be minimal conflict to the entering right turn traffic. **Figure 9** shows the graphic representation of the Peak Hour Warrant.

Figure 9 –Apartments & Commercial & Offices – Peak Hour Warrant



9.3 Capacity Analysis

Capacity analysis follows the methodology as outlined in Section 5. **Table 11** shows the results for the signalized study intersections. For the signalized intersection analysis, the same cycle lengths and phases were used for each scenario without modifications; however, individual timing splits were optimized.

Table 11: Existing Plus Apartments & Commercial & Offices
Signalized Intersection LOS (delay in seconds)

Intersection	AM Peak	PM Peak	Movement Notes (LOS E or poorer denoted)
Ward Road and Chipman Road	B (15.7)	C (20.3)	WBL-LOS E in AM (11vph)
Chipman Road and Donovan Road	B (15.1)	B (18.1)	

Table 12 shows the results for the stop controlled intersections. Geometry at the Ward Road and Tudor Road intersection includes a southbound left turn bay as being constructed as part of the Tudor Road extension project.

Table 12: Existing Plus Apartments & Commercial & Offices
Stop Controlled LOS (delay in seconds)

Intersection	AM Peak	PM Peak	Movement Notes (LOS E or poorer denoted)
Chipman Road and Drive 1 RIRO	B (13.3)	C (16.5)	
Ward Road and Drive 2 RIRO	B (10.9)	B (10.7)	
Ward Road and Donovan Road	E (35.2)	F (85.1)	WBL (AM=24vph; PM=81vph)
Ward Road and Drive 3 RIRO	B (12.6)	B (13.6)	
Ward Road and Tudor Road	E (42.3)	F (156)	WBL (AM=187vph; PM=232vph)
Tudor Road and Drive 4 RIRO	A (9.5)	A (9.8)	
Ward Road and Innovation Pkwy	C (20.5)	D (25.3)	

Similar to the Existing Traffic Volumes analysis, this analysis shows that the signalized intersection at Ward Road and Chipman is operating at a desired level of service. The intersection of Chipman Road and Donovan Road would operate well with signal control.

For unsignalized (stop controlled) study intersections, the Ward Road and Donovan Road intersection would operate poorly, particularly during the PM peak hour when LOS F would be expected. The AM peak LOS E is just over the LOS D threshold of 35.2 seconds of delay and thus is not as concerning as the PM peak hour of 85.1 seconds of delay. The number of westbound left exiting vehicles is anticipated to be 81 vph in the PM peak hour. Alternately, vehicles could exit at the Chipman/Donovan intersection or the RIRO drive on Ward Road during difficult peak periods. The volume of minor street right turns was included in the signal warrant evaluation but upon examination of the HCM delay, the level of service for this movement is LOS B, 13.8 seconds of delay. This satisfactory level of service suggests that signals would not be merited.

The intersection at Ward Road and Tudor Road, could operate at LOS E during the AM peak hour and LOS F during the PM peak hour, based on the HCM analysis (HCM 2010 methodology). The HCM analysis shows that the westbound left turn could experience 42.3 seconds of delay during the AM peak hour and 156 seconds of delay during the PM peak hour. A traffic signal would improve operations, but would not yet be warranted based on volumes. The queue analysis below contradicts this and signals could be justifiable based on queuing which suggests an unavailability of gaps to service the volume demand. Remember that the peak hour warrant is only a screening tool and consideration to other factors needs to be given.

9.4 Queuing Analysis (using SimTraffic)

Assuming the intersection of Ward Road and Tudor Road remains unsignalized, the westbound left turn queue could approach 325 feet (95th percentile queue). The average queue during this time is 156 feet with a maximum queue observed during the simulation being 362 feet. A 325-foot queue equates to about 13-16 cars. Although the volume of left turning vehicles is not much different than the prior scenario (Apartment & Commercial), it is the length of queuing and delay per vehicle that causes concern.

9.5 Turn Lane Assessment

The recommendation for left turn lanes is the same here as for the Apartments scenario, and the Apartments & Commercial scenario. The following left turn bay improvements are recommended.

Ward Road and Donovan Road:

A southbound left turn lane and northbound right turn lane are planned as a part of the intersection construction. Queues are small, less than 105 feet in all cases and can be contained in the turn lanes as planned.

Chipman Road and Donovan Road:

The expected left turn queues (less than 100 feet) can be easily contained within the minimum required 200-foot storage bay. Although not shown in the latest site plan exhibit, it is assumed that a minimum 150-foot right turn deceleration lane will be required (per the *Access Management Code*) for the westbound direction.

9.6 Existing Plus Apartments & Commercial & Offices Recommendations

Based on level of service, delay, queuing, auxiliary turn lane assessment, and signal warrant evaluations, the recommended improvements would be:

- Traffic signal at Chipman Road and Donovan Road
- Traffic signal at Ward Road and Tudor Road
- Left and right turn lanes from Ward Road onto Donovan Road
- Left and right turn lanes from Chipman Road onto Donovan Road
- Right turn lane at Ward Road and Tudor Road

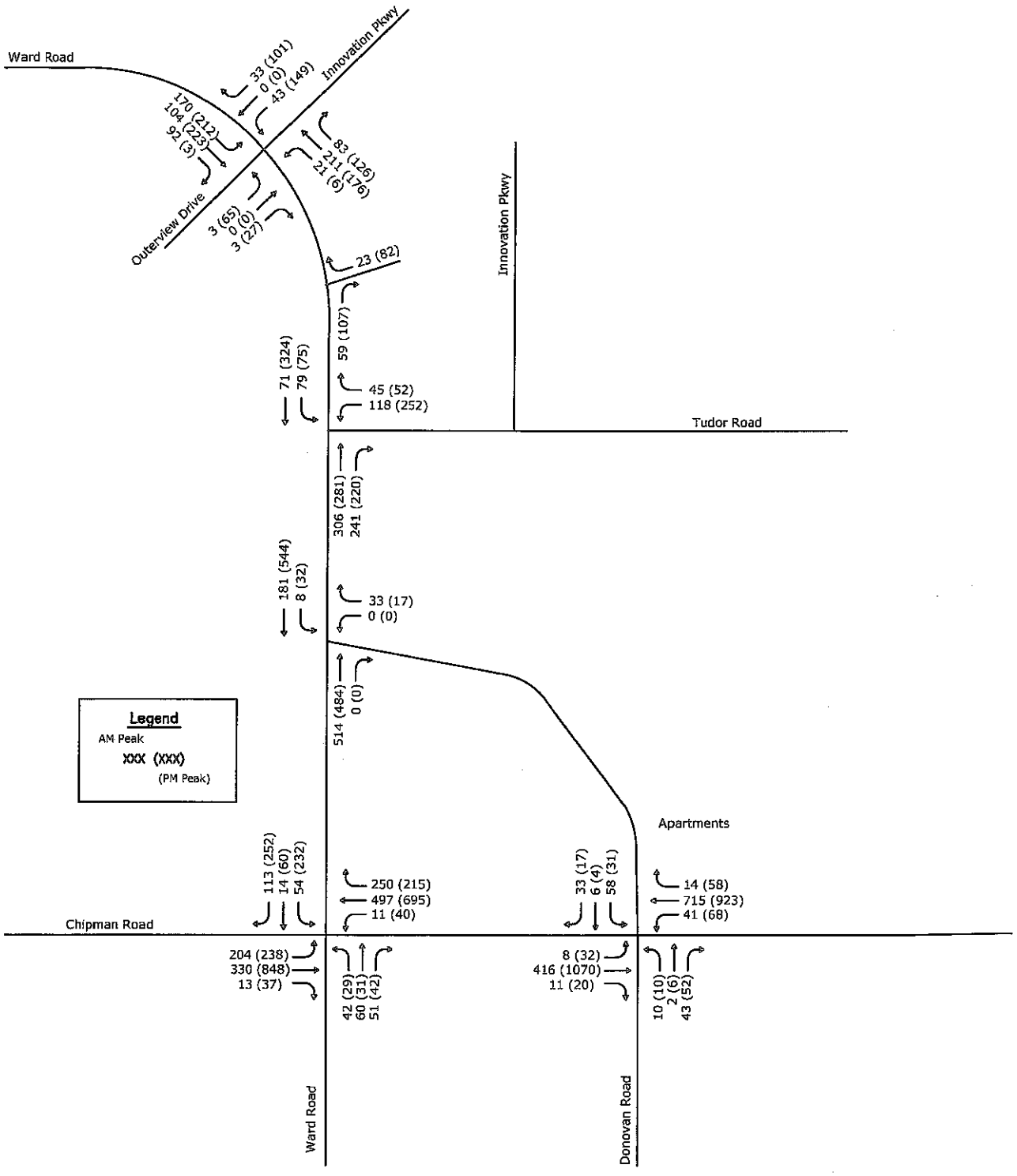
10.0 ADDITIONAL SCENARIOS WITH MIC FULL BUILD (Phase 1 and Phase 2)

10.1 Projected Volumes

Two additional scenarios were run and are both described in this section. These scenarios are:

- MIC Full Build Plus Apartments from Summit Orchards
- MIC Full Build Plus Apartments Plus Commercial from Summit Orchards

Projected volumes for these two scenarios are shown in **Figure 10** and **Figure 11**. Trip volumes from the Missouri Innovation Campus (MIC) traffic impact study for the Missouri Innovation Center, Phases 1 and 2 were used to generate the projected traffic volumes.



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Projected Volumes
MIC Full Build Plus Apartments, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

NORTH

FIGURE 10
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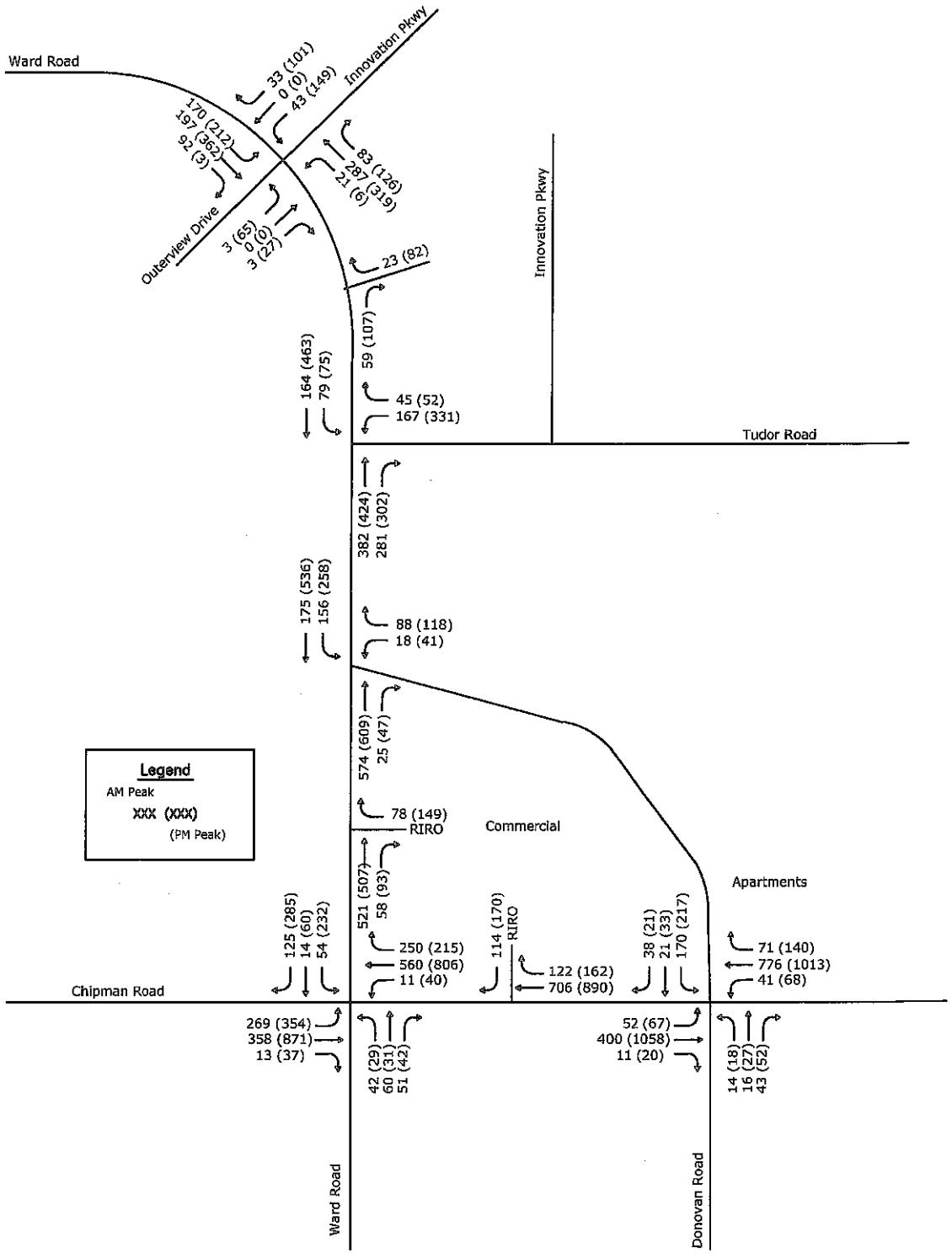

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Projected Volumes
MIC Full Build Plus Apartments & Commercial
Summit Orchards Traffic Impact Study
Lee's Summit, MO

NORTH

FIGURE 11
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10.2 Signal Warrant Analysis

Section 5.2 describes the signal warrant evaluations and how these were conducted. The usefulness of the Peak Hour Warrant (Warrant 3) as a screening tool was discussed.

Based on Warrant 3, the intersection of Chipman Road and Donovan Road would not need to be signalized until the commercial portion of Summit Orchards develops even with the full build out of the MIC site.

Likewise, the intersection of Ward and Tudor Road should be signalized if full build out of the MIC site has occurred and before the commercial portion of Summit Orchards has been built out.

The intersection of Ward and Donovan falls short of meeting signal warrant 3 even with full build out of the MIC site and addition of the apartments and commercial development. Minor street westbound right turns were included in the second scenario's (MIC Full Build Plus Apartments & Commercial) evaluation because through volumes on Ward increased enough that conflict was no longer minimal for entering right turn traffic. Figure 12 and Figure 13 shows the graphic representation of the Peak Hour Warrant.

Figure 12 –MIC Full Build Plus Apartments – Peak Hour Warrant

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PEAK HOUR SIGNAL WARRANT

1360 NW 121st Street
Clive, IA 50325
Ph (515) 961-1229

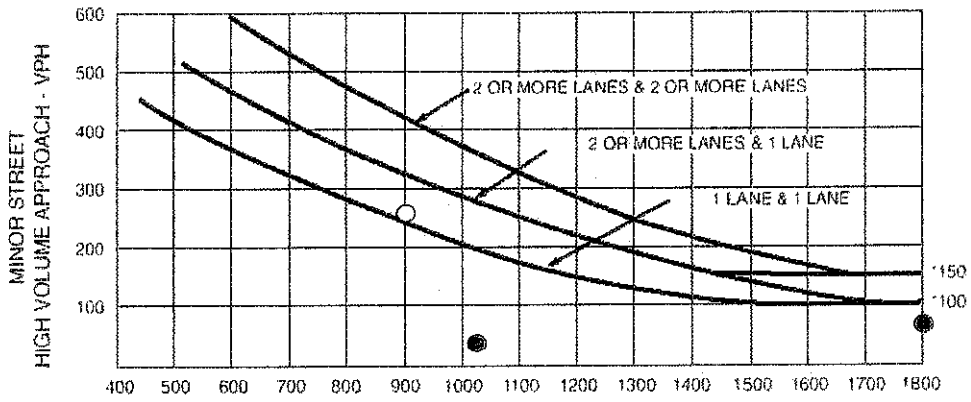
March 2016

SCENARIO: MIC Full Build Plus Existing Base Plus Apartments

INTERSECTIONS: ● Ward & Donovan (2/2) ○ Ward & Tudor (2/2)
● Chipman & Donovan (2/2)
number of approach lanes (major/minor) in parenthesis

PROJECT NAME: Summit Orchards

PEAK HOUR



*Note: 150 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor street approach with one lane.

Figure 13 –MIC Full Build Plus Apartments & Commercial
Peak Hour Warrant

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PEAK HOUR SIGNAL WARRANT

1360 NW 121st
Street
Clive, IA 50325
Ph (515) 964-1229

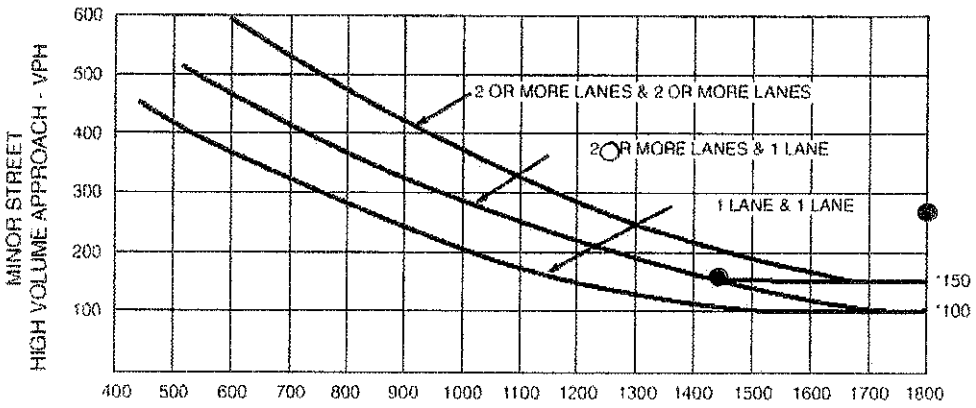
March 2016

SCENARIO: MIC Full Build Plus Existing Base Plus Apartments Plus Commercial

INTERSECTIONS: ● Ward & Donovan (2/2) ○ Ward & Tudor (2/2)
◉ Chipman & Donovan (2/2)
number of approach lanes (major/minor) in parenthesis

PROJECT NAME: Summit Orchards

PEAK HOUR



*Note: 150 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor street approach with one lane.

10.3 Capacity Analysis

Capacity analysis follows the methodology as outlined in Section 5. **Table 13** and **Table 14** show the results for the signalized study intersections for the two scenarios. For the signalized intersection analysis, the same cycle lengths and phases were used for each scenario without modifications; however, individual timing splits were optimized.

Table 13: MIC Full Build Plus Apartments
Signalized Intersection LOS (delay in seconds)

Intersection	AM Peak	PM Peak
Ward Road and Chipman Road	B (19.3)	B (18.0)

Table 14: MIC Full Build Plus Apartments & Commercial
Signalized Intersection LOS (delay in seconds)

Intersection	AM Peak	PM Peak
Ward Road and Chipman Road	B (18.8)	C (24.1)
Chipman Road and Donovan Road	B (14.3)	B (16.9)
Ward Road and Tudor Road	B (15.1)	C (24.0)
Ward Road and Innovation Pkwy	A (3.8)	B (17.6)

Table 15 and **Table 16** show the results for the stop controlled intersections for the two scenarios. Geometry at the Ward Road and Tudor Road intersection includes a southbound left turn bay as being constructed as part of the Tudor Road extension project.

Table 15: MIC Full Build Plus Apartments
Stop Controlled LOS (delay in seconds)

Intersection	AM Peak	PM Peak	Movement Notes (LOS E or poorer denoted)
Chipman Road and Donovan Road	E (47.2)	F (+300)	SBL (AM 58 vph; PM 31 vph)
Ward Road and Donovan Road	B (12.3)	B (11.7)	
Ward Road and Tudor Road	C (20.2)	F (99.7)	SBL (AM 118 vph; PM 252 vph)
Ward Road and Innovation Pkwy	C (21.7)	F (64.2)	SBL (AM 43 vph; PM 149 vph)

Table 16: MIC Full Build Plus Apartments & Commercial
Stop Controlled LOS (delay in seconds)

Intersection	AM Peak	PM Peak
Chipman Road and Drive 1 RIRO	B (13.3)	C (17.8)
Ward Road and Drive 2 RIRO	B (11.0)	B (12.1)
Ward Road and Donovan Road	D (32.6)	F (155.3)
Ward Road and Tudor Road	E (40.9)	F (+300)
Ward Road and Innovation Pkwy	D (29.3)	F (246)

Although the intersections of Ward Road/Tudor Road and Ward Road/Innovation Pkwy are shown as signal controlled, the stop control delay shown in **Table 16** provides additional information if these were to remain unsignalized. Although these two intersections may not yet meet the peak hour warrant, the delay to traffic becomes excessive at or near 300 seconds per vehicle. When that factor combines with the sidestreet volumes, queuing, availability of gaps and capacity of the intersection become concerning.

10.4 Queuing Analysis (using SimTraffic)

Assuming the intersection of Ward Road and Tudor Road remains unsignalized, the westbound left turn queue could approach 275 feet (95th percentile queue). A 275-foot queue equates to about 11-14 cars.

Assuming the intersection of Ward Road and Innovation Pkwy remains unsignalized, the westbound left turn queue could approach 146 feet (95th percentile queue). A 146-foot queue equates to about 6 cars.

In looking at the queues, there would be more justification for signalizing the Ward/Tudor intersection than the Ward/Innovation intersection under these scenarios. It would be reasonable to plan for a signal at Ward/Tudor and monitor the Ward/Innovation intersection upon full build out of MIC and once the apartments are completed and commercial portion of Summit Orchards is under way.

10.5 Turn Lane Assessment

Ward Road and Donovan Road:
A southbound left turn lane and northbound right turn lane are planned as a part of the intersection construction. Queues cases and can be contained in the turn lane lengths as planned.

Chipman Road and Donovan Road:
The expected left turn queues (less than 100 feet) can be easily contained within the minimum required 200-foot storage bay. Although not shown in the latest site plan exhibit, it is assumed that a minimum 150-foot right turn deceleration lane will be required (per the *Access Management Code*) for the westbound direction.

10.6 MIC Full Build Plus Apartments Plus Commercial Summit Orchards Recommendations

Based on level of service, delay, queuing, auxiliary turn lane assessment, and signal warrant evaluations, the recommended improvements would be:

- Traffic signal at Chipman Road and Donovan Road
- Traffic signal at Ward Road and Tudor Road
- Left and right turn lanes from Ward Road onto Donovan Road
- Left and right turn lanes from Chipman Road onto Donovan Road
- Right turn lane at Ward Road and Tudor Road
- Monitor the intersection of Ward/Innovation for possible signal.

These improvements should be completed prior to the completion of the commercial lots being built out and with the full build out of the MIC site to the north.

11.0 ADT EVALUATION AND WARD ROAD WIDENING

11.1 Projected Average Daily Traffic Volumes

To assist in determining when widening of Ward Road from 2-lanes to 4-lanes should occur, an extrapolation of peak hour data to ADT data was completed. These "extrapolations" are shown in Figure ADT 1, Figure ADT 2, Figure ADT 3 and Figure ADT 4. Historical data from count stations located on Chipman Road show that on average, the PM peak hour made up 12-13 percent of the average daily traffic (ADT). The most recent 24-hour count at Donovan showed that the PM peak hour made up 9 percent of the ADT. The figures provide a range of ADT based on a 10% and 12% extrapolation of the data.

In order to evaluate these ADT values, parameters must be set regarding roadway capacity. The 2010 Highway Capacity Manual and the 2011 AASHTO "Green Book" should be used in the design of the roadway to determine the number of lanes and intersection configuration at the desired LOS. As a broad evaluation, the capacities of two lane highways are suggested as below. This table comes from a Des Moines MPO planning document. An attempt was made to find similar information from the Mid-American Regional Council (MARC, the KC MPO) website, but the Metropolitan Transportation Plan does not provide such guidance.

Table 12: Planning Capacity at LOS "C" and "D"
Two Way Arterial Streets (non-intersection)

Number of Lanes	Turn Lanes	Access Condition (side friction)			
		Minimal	Light (Residential)	Moderate (Mixed Zoning)	Heavy
		(VPD) C/D Capacity	(VPD) C/D Capacity	(VPD) C/D Capacity	(VPD) C/D Capacity
2 Lanes Undivided	Without turn lanes (2 lane div. w/o turn lanes)	10,700/ 12,900	10,000/ 12,000	9,100/ 10,900	7,500/ 9,000
	With left turn lanes (2 lane div. with turn lanes) (3 lane w/center turn lane)	12,500/ 15,000	11,600/ 14,000	10,800/ 13,000	9,100/ 11,000

Using this guidance, assuming moderate side friction from access points, and that LOS C would be desirable, while LOS D could be acceptable, one can see from the ADT Figures that Ward Road could operate acceptably at an upper range of 10,800 to 13,000 vehicles per day (vpd) with left turn lanes being provided at intersections.

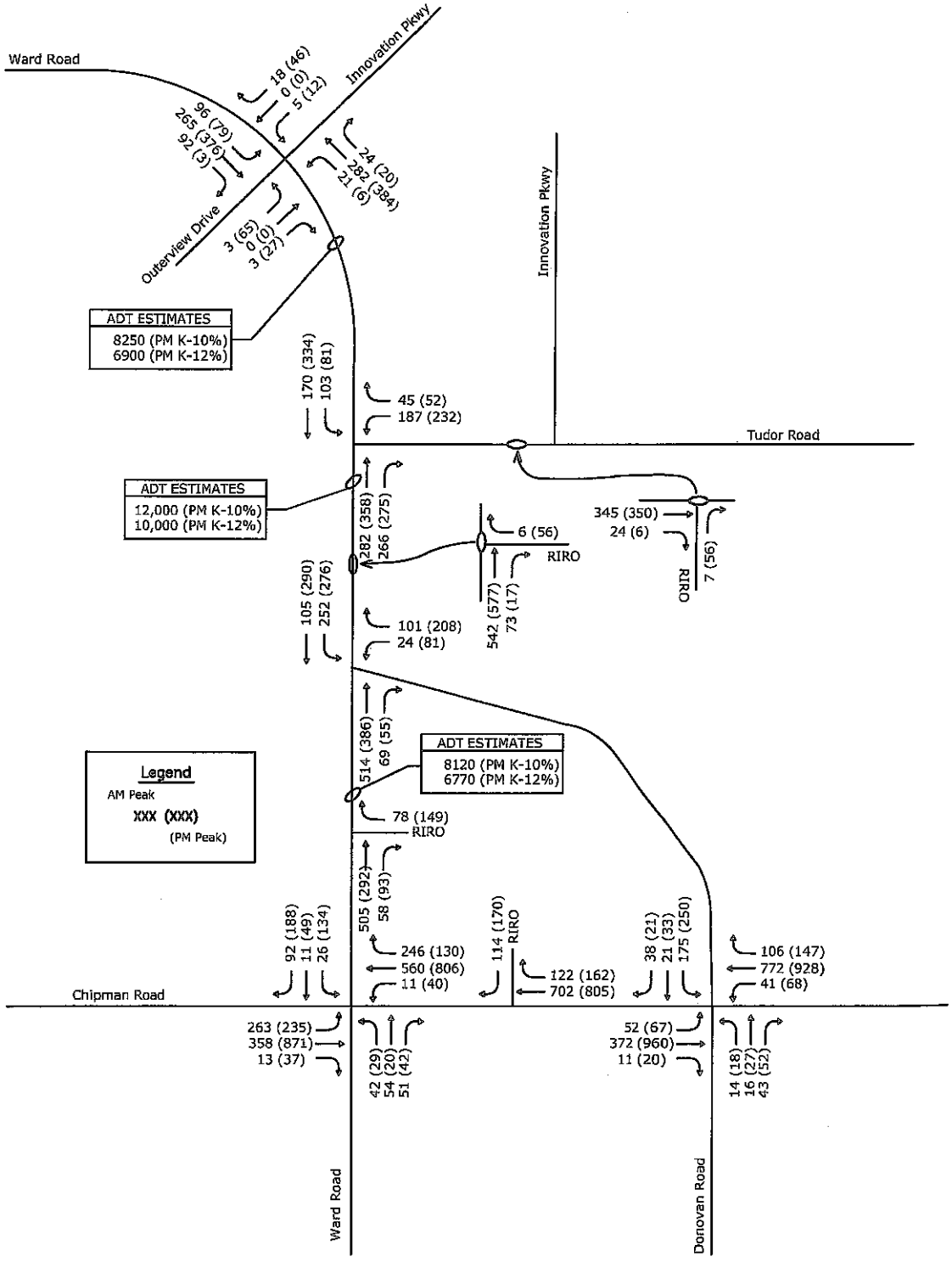
A comparison of the thresholds against the estimated ADT ranges provides an idea of when widening may be needed on Ward Road. The assumption is that Phase 1 MIC would already be constructed. Its volumes were included in the existing traffic volume for each analysis scenario. Conclusions are that:

- Ward Road could remain a 2-lane facility with left turn lanes with the MIC Phase 1 (education building) completion and with the complete build of Summit Orchards (Apartments, Commercial and Offices);
- Ward Road could remain a 2-lane facility with left turn lanes with the full build out of MIC Phase 1 and Phase 2 and with the completion of the Summit Orchards Apartments;

- Ward Road should be widened to a 4-lane facility with the completion of the Commercial portion of Summit Orchards if MIC is fully built out (Phase 1 and Phase 2) at that time; otherwise Ward Road could remain a 2-lane facility
- Ward Road should be widened when Summit Place is built regardless of other development. This conclusion was reached in prior studies and is supported by Figure ADT 4.

In addition to widening, consideration for traffic signals should be a part of the overall corridor plan. Again, the assumption is that Phase 1 MIC would already be constructed and is part of the existing traffic volume. Based on information presented in previous sections, the following can be concluded:

- Chipman Road & Donovan Road – Signals should be installed with the commercial development portion of the site.
- Ward Road & Donovan Road – Based on the current projections, signal warrants would not be met here under any of the various circumstances. If the trip distribution does not play out as expected, then potentially they could be needed at some point in the future.
- Ward Road & Tudor Road – several circumstances could trigger the need for traffic signals at this intersection. These are:
    1. Signals would be warranted upon build out of all three phases (apartments, commercial and offices) of Summit Orchard regardless of other development.
    2. Signals would be warranted upon full build out of the MIC site and the build of the apartments plus commercial portion of Summit Orchards.
    3. Signals would be warranted during the build out of Summit Place independent of other development.
- Ward Road & Innovation Pkwy – recommend a traffic signal upon build out of Summit Place but only when MIC Phase 2 Plus additional lots is developed (full build out along the corridor). Otherwise monitor the intersection for signal needs once MIC is fully built out.



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Projected Volumes, Phases 1 & 2 & 3
Apartments, Commercial, Offices, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

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ADT 1
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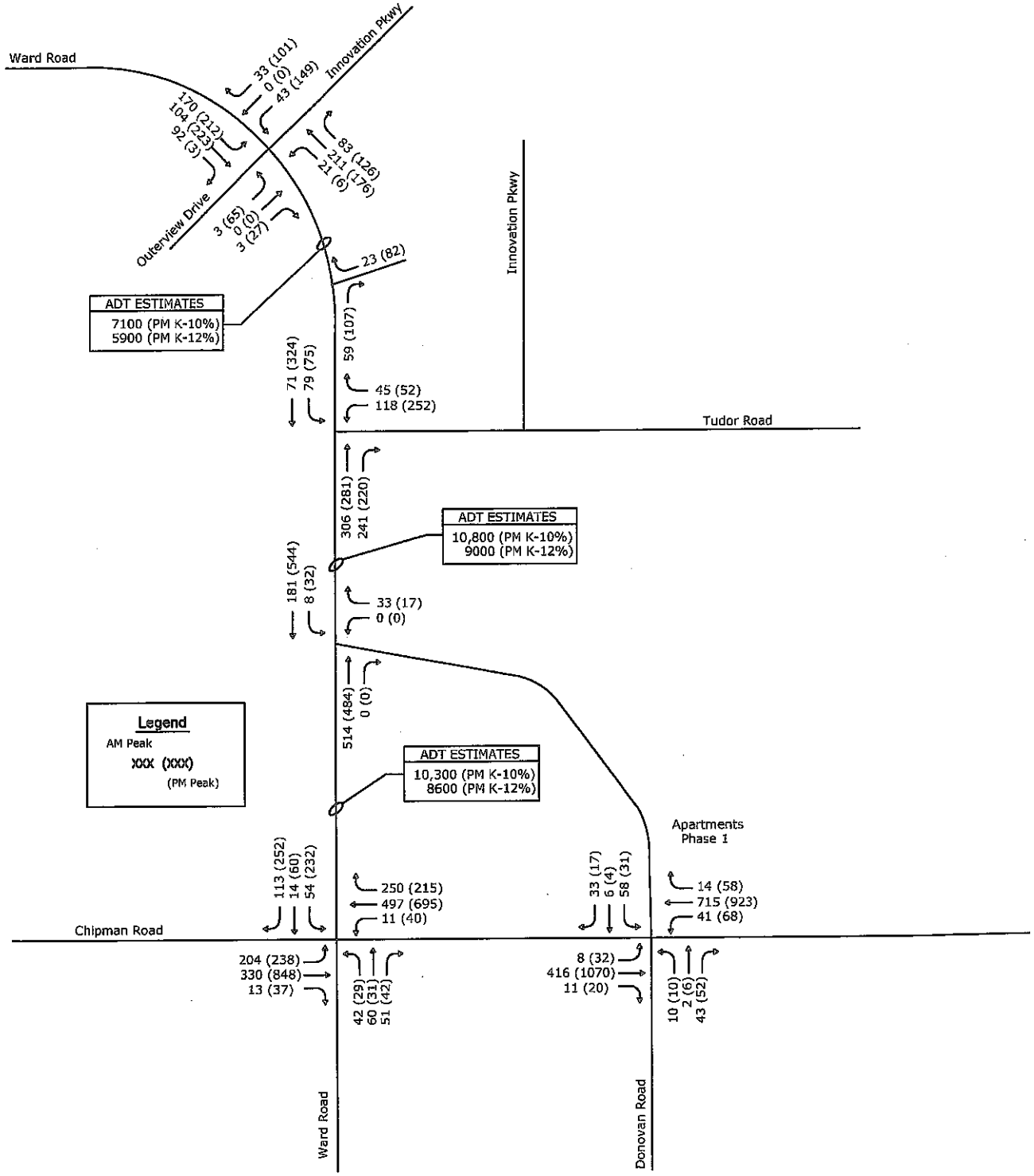

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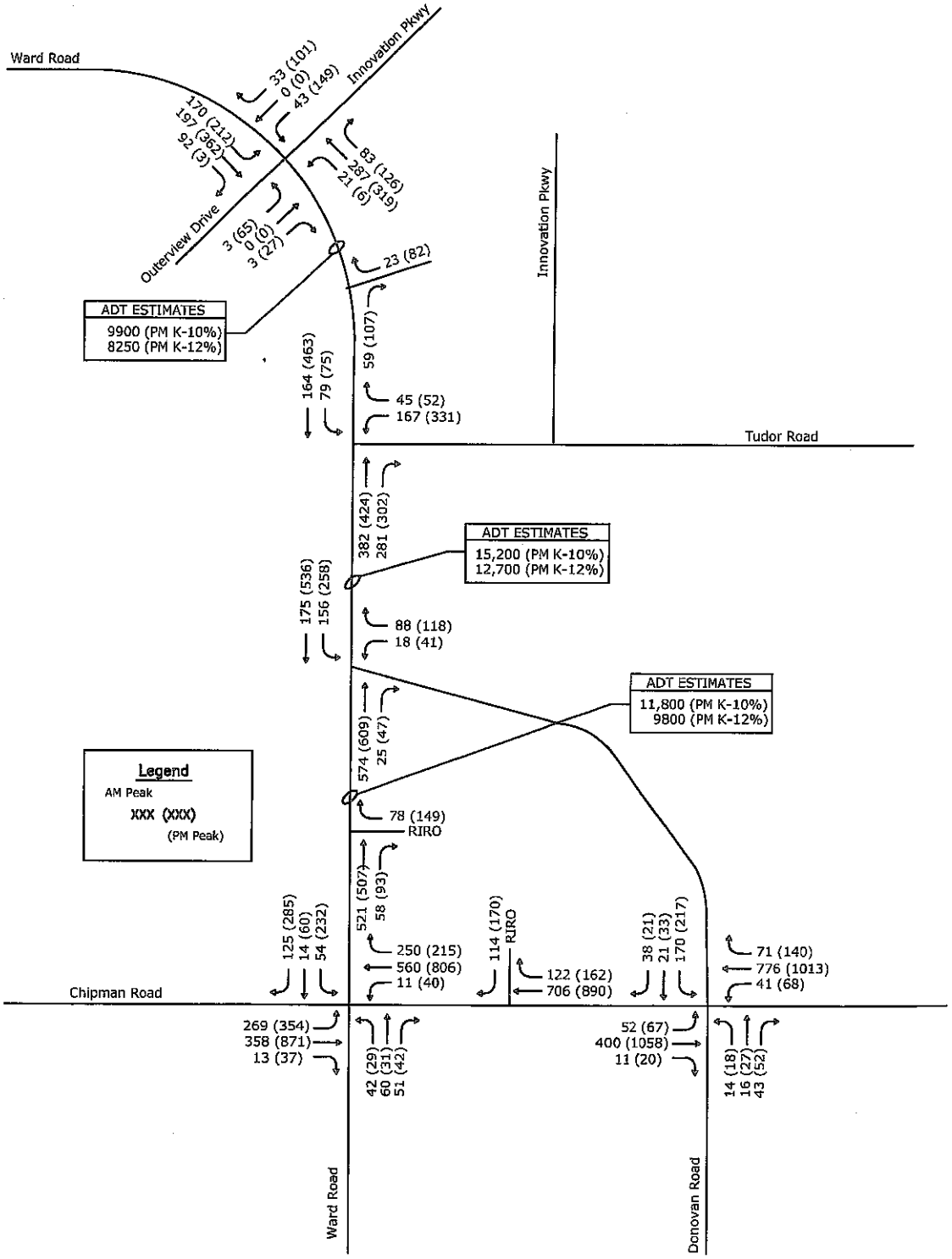

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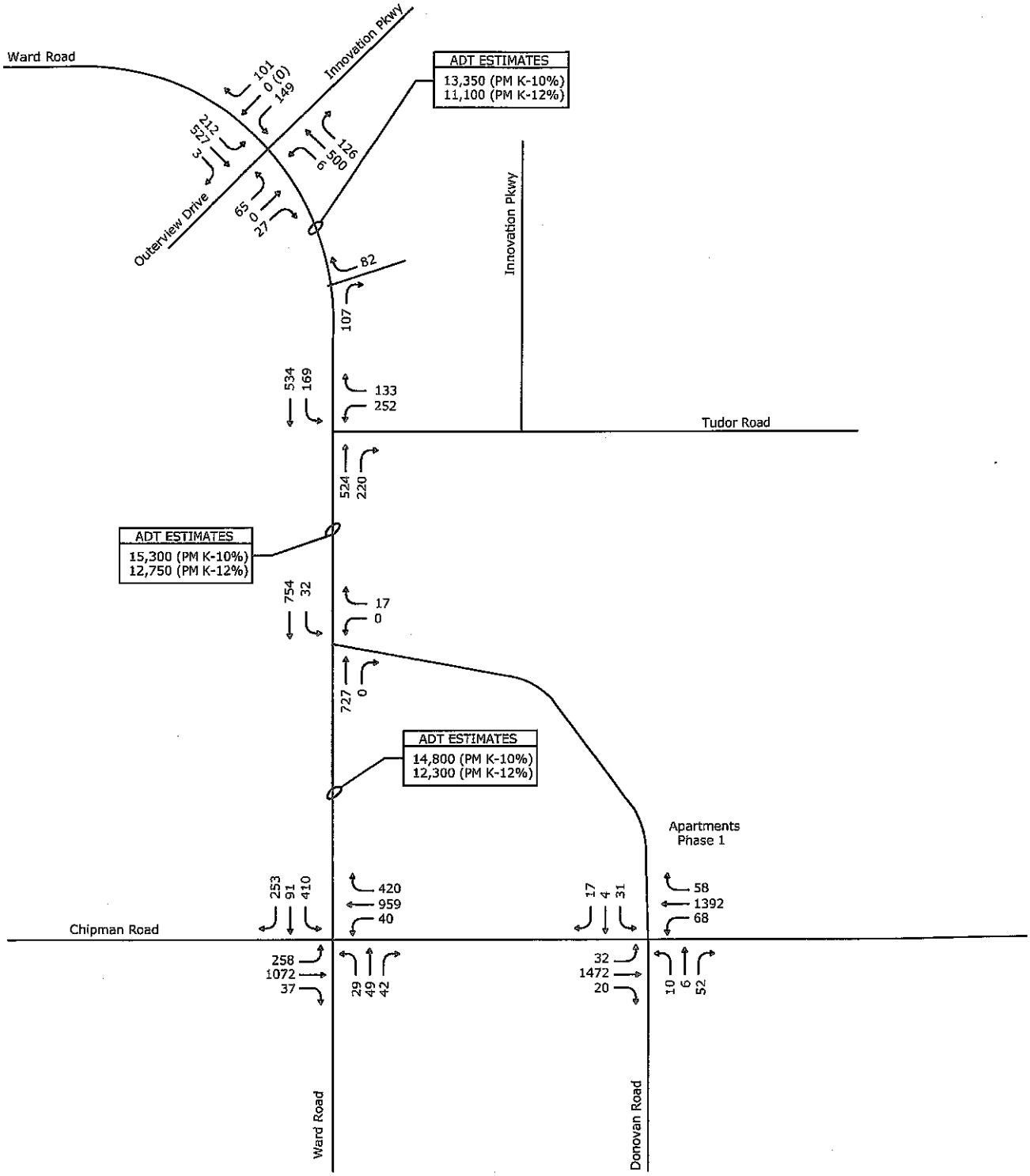
Projected Volumes, MIC Full Build + Phases 1 & 2
MIC Full Build Plus Apartments & Commercial
Summit Orchards Traffic Impact Study
Lee's Summit, MO

NORTH



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Projected Volumes, MIC Full Build Plus
Phase 1 Apts. Plus Summit Fair & Summit Place
Traffic Impact Study
Lee's Summit, MO

NORTH

12.0 RECOMMENDATIONS

Based on level of service, delay, queuing, auxiliary turn lane assessment, and signal warrant evaluations, the following recommendations are being made. All recommendations meet the requirements per the Lees' Summit *Access Management Code*.

- Chipman Road and Donovan Road – Install a minimum 200-foot left turn storage bay and a minimum 150-foot right turn lane from Chipman Road onto Donovan Road. Signals should be installed with the commercial development portion of the site.

- Ward Road and Donovan Road - Install a minimum 200-foot left turn storage bay and a minimum 150-foot right turn lane from Ward Road onto Donovan Road. Based on the current projections, signal warrants would not be met here under any of the various circumstances. If the trip distribution does not play out as expected, then potentially they could be needed at some point in the future.

- Both right-in, right-out entrances (one on Ward; one on Chipman) can be constructed without auxiliary lanes.

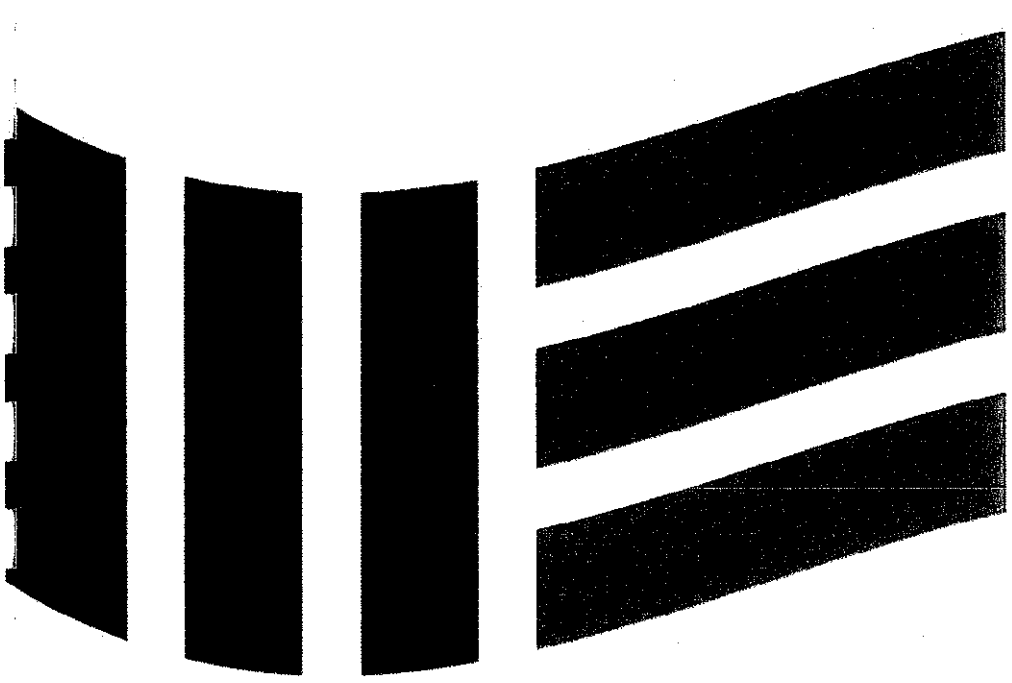
- Ward and Tudor - A southbound left turn lane on Ward Road at Tudor Road is already planned as a part of the Tudor Road extension project. Installation of a northbound right turn lane should be reconsidered when Ward Road is widened to 4-lanes. Several circumstances could trigger the need for traffic signals. These are:
    1. Signals would be warranted upon build out of all three phases (apartments, commercial and offices) of Summit Orchard regardless of other development.
    2. Signals would be warranted upon full build out of the MIC site and the build of the apartments plus commercial portion of Summit Orchards.
    3. Signals would be warranted during the build out of Summit Place independent of other development.

- Ward Road & Innovation Pkwy – recommend a traffic signal upon build out of Summit Place but only when MIC Phase 2 Plus additional lots is developed (full build out along the corridor). Otherwise monitor the intersection for signal needs once MIC is fully built out.

Based on the ADT comparisons on Ward road, conclusions for widening Ward Road are that:

- Ward Road could remain a 2-lane facility with left turn lanes with the MIC Phase 1 (education building) completion and with the complete build of Summit Orchards (Apartments, Commercial and Offices);
- Ward Road could remain a 2-lane facility with left turn lanes with the full build out of MIC Phase 1 and Phase 2 and with the completion of the Summit Orchards Apartments;
- Ward Road should be widened to a 4-lane facility with the completion of the Commercial portion of Summit Orchards if MIC is fully built out (Phase 1 and Phase 2) at that time; otherwise Ward Road could remain a 2-lane facility;
- Ward Road should be widened when Summit Place is built regardless of other development.

APPENDICES
SUMMIT ORCHARDS TRAFFIC IMPACT STUDY
CITY OF LEE'S SUMMIT
March 2016



Appendices

McCLURE™

Appendix A: Traffic Count Data

Appendix A: Traffic Count Data

McClure Engineering Company
1360 NW 121st Street

Clive, Iowa, United States 50325
515-964-1229 lvandenberg@mecresults.com

Count Name: Chipman Road & Donovan Road
TMC
Site Code:
Start Date: 03/03/2016
Page No: 1

Turning Movement Data

Start Time	Donovan Road Southbound					Chipman Road Westbound					Donovan Road Northbound					Chipman Road Eastbound					
	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	Int. Total
12:00 AM	0	0	0	0	0	2	6	0	0	8	0	0	0	0	0	0	66	1	0	67	75
12:15 AM	0	0	0	0	0	2	6	0	0	8	0	0	0	0	0	0	18	0	0	18	26
12:30 AM	0	0	0	0	0	2	10	0	0	12	0	0	0	0	0	0	11	0	0	11	23
12:45 AM	0	0	0	0	0	0	6	0	0	6	0	0	1	0	1	0	5	0	0	5	12
Hourly Total	0	0	0	0	0	6	28	0	0	34	0	0	1	0	1	0	100	1	0	101	136
1:00 AM	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	5	0	0	5	8
1:15 AM	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	6	0	0	6	9
1:30 AM	0	0	0	0	0	1	6	0	0	7	1	0	0	0	1	0	5	0	0	5	13
1:45 AM	0	0	0	0	0	1	4	0	0	5	0	0	0	0	0	0	8	0	0	8	13
Hourly Total	0	0	0	0	0	2	16	0	0	18	1	0	0	0	1	0	24	0	0	24	43
2:00 AM	0	0	0	0	0	0	1	0	0	1	0	0	1	0	1	0	6	0	0	6	8
2:15 AM	0	0	0	0	0	0	8	0	0	8	0	0	0	0	0	0	2	0	0	2	10
2:30 AM	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	0	5	0	0	5	9
2:45 AM	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	3	0	0	3	6
Hourly Total	0	0	0	0	0	0	16	0	0	16	0	0	1	0	1	0	16	0	0	16	33
3:00 AM	0	0	0	0	0	1	1	0	0	2	0	0	0	0	0	0	2	0	0	2	4
3:15 AM	0	0	0	0	0	1	4	0	0	5	0	0	0	0	0	0	1	0	0	1	6
3:30 AM	0	0	0	0	0	1	4	0	0	5	0	0	0	0	0	0	4	0	0	4	9
3:45 AM	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	2	0	0	2	5
Hourly Total	0	0	0	0	0	3	12	0	0	15	0	0	0	0	0	0	9	0	0	9	24
4:00 AM	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	6	0	0	6	9
4:15 AM	0	0	0	0	0	1	5	0	0	6	0	0	1	0	1	0	5	0	0	5	12
4:30 AM	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	0	4	1	0	5	9
4:45 AM	0	0	0	0	0	1	12	0	0	13	0	0	0	0	0	0	12	0	0	12	25
Hourly Total	0	0	0	0	0	2	24	0	0	26	0	0	1	0	1	0	27	1	0	28	55
5:00 AM	0	0	0	0	0	1	10	0	0	11	2	0	2	0	4	0	13	0	0	13	28
5:15 AM	0	0	0	0	0	0	26	0	0	26	0	0	1	0	1	0	7	0	1	8	35
5:30 AM	0	0	0	0	0	1	57	0	0	58	2	0	1	0	3	0	20	2	0	22	83
5:45 AM	0	0	0	0	0	2	83	0	0	85	3	0	1	0	4	0	30	1	0	31	100
Hourly Total	0	0	0	0	0	4	156	0	0	160	7	0	5	0	12	0	70	3	1	74	246
6:00 AM	0	0	0	0	0	2	47	1	0	50	3	0	6	0	9	0	18	1	0	19	78
6:15 AM	0	0	0	0	0	5	57	2	0	64	6	0	3	0	9	0	28	0	0	28	101
6:30 AM	0	0	0	0	0	7	69	1	0	77	5	0	7	0	12	0	51	1	0	52	141
6:45 AM	1	0	0	0	1	7	111	0	0	118	3	0	14	0	17	0	67	1	0	68	204
Hourly Total	1	0	0	0	1	21	284	4	0	309	17	0	30	0	47	0	164	3	0	167	524
7:00 AM	0	0	0	0	0	3	111	0	0	114	7	0	9	0	16	0	85	1	0	86	216
7:15 AM	0	0	0	0	0	7	141	0	1	149	5	0	9	0	14	0	85	2	0	87	250
7:30 AM	0	0	1	0	1	10	161	0	1	172	0	0	8	0	8	0	89	2	0	91	272

7:45 AM	0	0	0	0	0	14	145	0	0	159	5	0	16	0	21	0	112	5	0	117	297
Hourly Total	0	0	1	0	1	34	558	0	2	594	17	0	42	0	59	0	371	10	0	381	1035
8:00 AM	0	0	0	0	0	10	129	0	1	140	0	0	10	0	10	0	86	2	1	89	239
8:15 AM	0	0	0	0	0	8	110	1	1	120	4	0	15	0	19	0	103	1	1	105	244
8:30 AM	0	0	0	0	0	8	110	0	0	118	3	0	13	0	16	0	110	3	0	113	247
8:45 AM	0	0	0	0	0	9	129	0	0	138	4	0	13	0	17	0	110	0	2	112	267
Hourly Total	0	0	0	0	0	35	478	1	2	516	11	0	51	0	62	0	409	6	4	419	997
9:00 AM	0	0	0	0	0	8	127	0	0	135	1	0	5	0	6	0	98	2	0	100	241
9:15 AM	0	0	0	0	0	10	135	0	0	145	4	0	6	0	10	0	113	3	1	117	272
9:30 AM	0	0	0	0	0	7	133	1	0	141	2	0	5	0	7	0	99	2	0	101	249
9:45 AM	1	0	0	0	1	10	116	0	0	126	2	0	8	0	10	0	129	0	0	129	266
Hourly Total	1	0	0	0	1	35	511	1	0	547	9	0	24	0	33	0	439	7	1	447	1028
10:00 AM	0	0	0	0	0	3	137	0	0	140	0	0	8	0	8	0	131	2	0	133	281
10:15 AM	0	0	0	0	0	8	122	0	1	131	0	0	11	0	11	0	142	2	0	144	286
10:30 AM	0	0	0	0	0	13	138	0	0	151	4	0	5	0	9	0	154	1	0	155	315
10:45 AM	0	0	0	0	0	8	142	0	1	151	1	0	3	0	4	0	163	3	0	166	321
Hourly Total	0	0	0	0	0	32	539	0	2	573	5	0	27	0	32	0	590	8	0	598	1203
11:00 AM	0	0	0	0	0	8	169	0	1	178	2	0	6	0	8	0	145	4	0	149	335
11:15 AM	0	0	1	0	1	5	169	0	0	174	2	0	3	0	5	0	144	1	0	145	325
11:30 AM	0	0	0	0	0	11	209	0	0	220	2	0	6	0	8	0	163	3	1	167	395
11:45 AM	0	0	0	0	0	6	182	1	0	189	2	0	9	0	11	0	146	2	1	149	349
Hourly Total	0	0	1	0	1	30	729	1	1	761	8	0	24	0	32	0	598	10	2	610	1404
12:00 PM	0	0	0	0	0	10	207	0	1	218	5	0	11	0	16	0	225	1	0	226	460
12:15 PM	0	0	0	0	0	16	201	0	1	218	2	0	8	0	10	0	162	4	0	166	394
12:30 PM	0	0	0	0	0	15	215	0	1	231	5	0	4	0	9	0	195	4	0	199	439
12:45 PM	0	0	0	0	0	12	162	0	1	175	4	0	9	0	13	0	185	1	0	186	384
Hourly Total	0	0	0	0	0	53	785	0	4	842	16	0	32	0	48	0	777	10	0	787	1677
1:00 PM	0	0	0	0	0	10	193	0	0	203	3	0	5	0	8	0	191	5	0	196	407
1:15 PM	0	0	1	0	1	13	233	1	1	248	1	0	13	0	14	0	162	2	1	165	428
1:30 PM	0	0	1	0	1	9	180	0	0	189	2	0	13	0	15	1	178	2	0	179	384
1:45 PM	0	0	0	0	0	16	183	0	0	199	3	0	11	0	14	0	195	4	0	199	412
Hourly Total	0	0	2	0	2	48	789	1	1	839	9	0	42	0	51	1	724	13	1	739	1631
2:00 PM	0	0	0	0	0	19	145	0	2	166	1	0	10	0	11	0	202	2	0	204	381
2:15 PM	0	0	0	0	0	13	158	0	0	169	6	0	11	0	17	0	176	3	0	179	365
2:30 PM	0	0	0	0	0	11	212	1	0	224	0	0	8	0	8	0	235	2	1	238	470
2:45 PM	0	0	0	0	0	12	193	0	1	206	3	0	5	0	8	0	171	7	0	178	392
Hourly Total	0	0	0	0	0	55	706	1	3	765	10	0	34	0	44	0	784	14	1	799	1608
3:00 PM	0	0	0	0	0	20	192	0	0	212	2	0	8	0	10	0	209	7	1	217	439
3:15 PM	0	0	0	0	0	13	168	0	0	181	1	0	11	0	12	0	213	2	0	215	408
3:30 PM	0	0	0	0	0	25	165	0	1	191	2	0	15	0	17	0	205	5	0	210	418
3:45 PM	0	0	0	0	0	28	203	0	0	231	3	0	12	0	15	0	176	0	0	175	421
Hourly Total	0	0	0	0	0	86	728	0	1	815	8	0	46	0	54	0	802	14	1	817	1686
4:00 PM	0	0	0	0	0	16	236	0	0	252	2	0	10	0	12	0	185	7	0	192	456
4:15 PM	0	0	0	0	0	14	178	0	0	192	3	0	11	0	14	0	219	3	0	222	428
4:30 PM	0	0	0	0	0	21	172	0	0	193	3	0	12	0	15	0	212	6	1	219	427
4:45 PM	0	0	0	0	0	16	182	0	1	199	3	0	13	0	16	0	253	4	0	257	472
Hourly Total	0	0	0	0	0	67	768	0	1	836	11	0	46	0	57	0	869	20	1	890	1783
5:00 PM	0	0	0	0	0	20	213	0	1	234	4	0	14	0	18	0	229	5	0	234	486
5:15 PM	0	0	1	0	1	18	183	0	1	202	5	0	13	0	18	0	220	2	0	222	443
5:30 PM	1	1	1	0	3	18	159	0	0	177	1	0	13	0	14	0	235	7	0	242	436
5:45 PM	0	0	0	0	0	12	201	0	1	214	0	0	12	0	12	0	245	6	0	252	478
Hourly Total	1	1	2	0	4	68	756	0	3	827	10	0	52	0	62	0	930	20	0	950	1843

6:00 PM	0	0	0	0	0	18	189	0	0	207	1	0	6	0	7	0	218	3	2	223	437
6:15 PM	0	0	0	0	0	17	180	0	0	197	1	0	7	0	8	0	173	2	0	175	380
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6:45 PM	0	0	0	0	0	15	138	0	1	154	0	0	7	0	7	0	191	1	0	192	353
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7:00 PM	0	0	0	0	0	9	161	0	1	171	2	0	7	0	9	0	148	2	0	150	330
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7:30 PM	0	0	0	0	0	9	120	0	0	129	1	0	5	0	6	0	115	0	0	115	250
7:45 PM	0	0	0	0	0	9	131	0	0	140	1	0	4	0	5	0	140	2	0	142	287
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8:15 PM	0	0	0	0	0	10	82	0	0	92	1	0	2	0	3	0	88	3	0	91	186
8:30 PM	0	0	0	0	0	6	94	0	0	102	0	0	3	0	3	0	93	2	0	95	200
8:45 PM	0	0	0	0	0	5	82	0	0	87	2	0	1	0	3	0	80	2	0	82	172
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9:00 PM	0	0	0	0	0	9	70	0	1	80	1	0	1	0	2	0	93	2	0	95	177
9:15 PM	0	0	0	0	0	4	56	0	0	60	1	0	3	0	4	0	66	1	0	67	131
9:30 PM	0	0	0	0	0	2	39	0	0	41	0	0	0	0	0	0	71	3	0	74	115
9:45 PM	0	0	0	0	0	2	43	0	0	45	3	0	2	0	5	0	54	1	0	55	105
Hourly Total	0	0	0	0	0	17	208	0	1	226	5	0	6	0	11	0	284	7	0	291	528
10:00 PM	0	0	0	0	0	7	37	0	0	44	1	0	0	0	1	0	37	1	0	38	83
10:15 PM	0	0	0	0	0	0	29	0	0	29	0	0	0	0	0	0	40	1	1	42	71
10:30 PM	0	0	0	0	0	3	30	0	0	33	2	0	0	0	2	0	40	1	0	41	76
10:45 PM	0	0	0	0	0	1	22	0	0	23	0	0	1	0	1	0	29	0	0	29	53
Hourly Total	0	0	0	0	0	11	118	0	0	129	3	0	1	0	4	0	146	3	1	150	283
11:00 PM	0	0	0	0	0	2	13	0	0	15	0	0	0	0	0	0	25	0	0	25	40
11:15 PM	0	0	0	0	0	2	20	0	0	22	0	0	0	0	0	0	20	0	0	20	42
11:30 PM	0	0	0	0	0	4	16	0	0	20	0	0	2	0	2	0	19	0	0	19	41
11:45 PM	0	0	0	0	0	1	20	1	0	22	0	0	0	0	0	0	13	1	0	14	36
Hourly Total	0	0	0	0	0	9	69	1	0	79	0	0	2	0	2	0	77	1	0	78	159
Grand Total	3	1	6	0	10	751	9844	10	24	10629	163	0	530	0	693	1	9919	176	17	10113	21445
Approach %	30.0	10.0	60.0	0.0	-	7.1	92.6	0.1	0.2	-	23.5	0.0	76.5	0.0	-	0.0	98.1	1.7	0.2	-	-
Total %	0.0	0.0	0.0	0.0	0.0	3.5	45.9	0.0	0.1	49.6	0.8	0.0	2.5	0.0	3.2	0.0	46.3	0.8	0.1	47.2	-
Lights	3	1	6	0	10	737	9718	10	24	10490	155	0	523	0	678	1	9804	159	17	9981	21159
% Lights	100.0	100.0	100.0	-	100.0	98.1	98.7	100.0	100.0	98.7	95.1	-	98.7	-	97.8	100.0	98.8	90.3	100.0	98.7	98.7
Mediums	0	0	0	0	0	14	111	0	0	125	6	0	7	0	13	0	99	14	0	113	251
% Mediums	0.0	0.0	0.0	-	0.0	1.9	1.1	0.0	0.0	1.2	3.7	-	1.3	-	1.9	0.0	1.0	8.0	0.0	1.1	1.2
Articulated Trucks	0	0	0	0	0	0	14	0	0	14	2	0	0	0	2	0	16	3	0	19	35
% Articulated Trucks	0.0	0.0	0.0	-	0.0	0.0	0.1	0.0	0.0	0.1	1.2	-	0.0	-	0.3	0.0	0.2	1.7	0.0	0.2	0.2

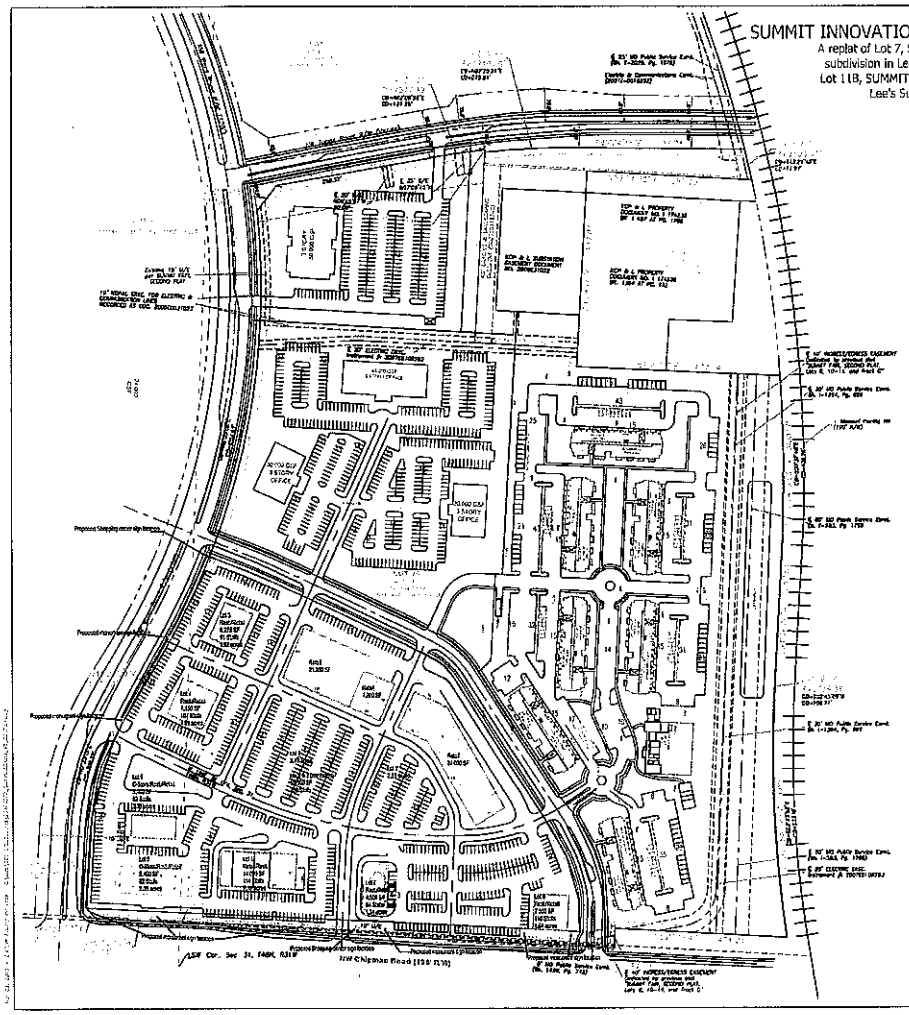
Appendix B: Site Layouts

Appendix B: Site Layouts

A Minor Plat of

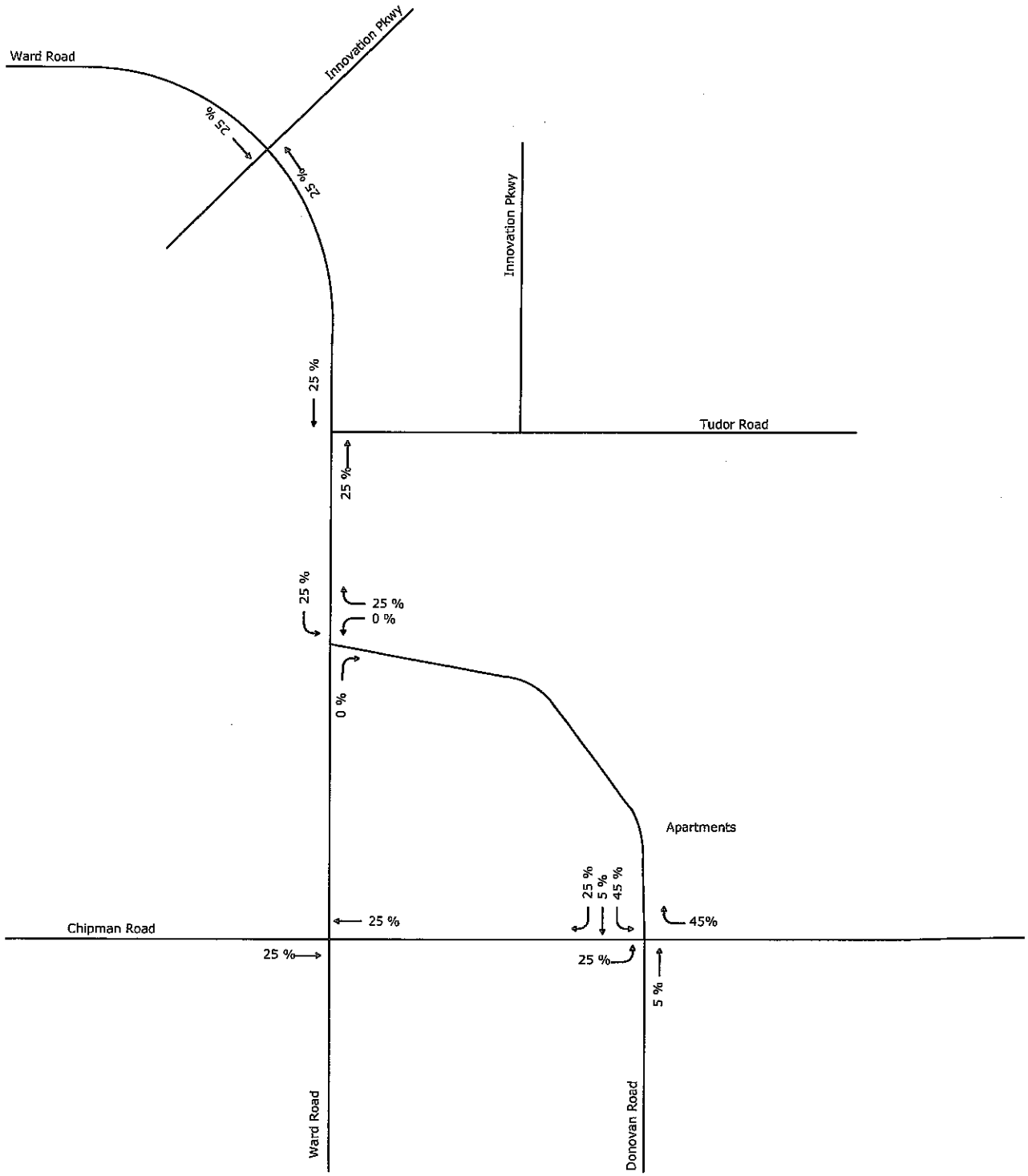
SUMMIT INNOVATION CENTER - 2nd PLAT, Lots 7A and 8

A replat of Lot 7, SUMMIT INNOVATION CENTER 1st PLAT, a subdivision in Lee's Summit, Jackson County, Missouri and Lot 11B, SUMMIT FAIR , Lot 11A & Lot 11B, a subdivision in Lee's Summit, Jackson County, Missouri.



Appendix F: Trip Generation Distributions

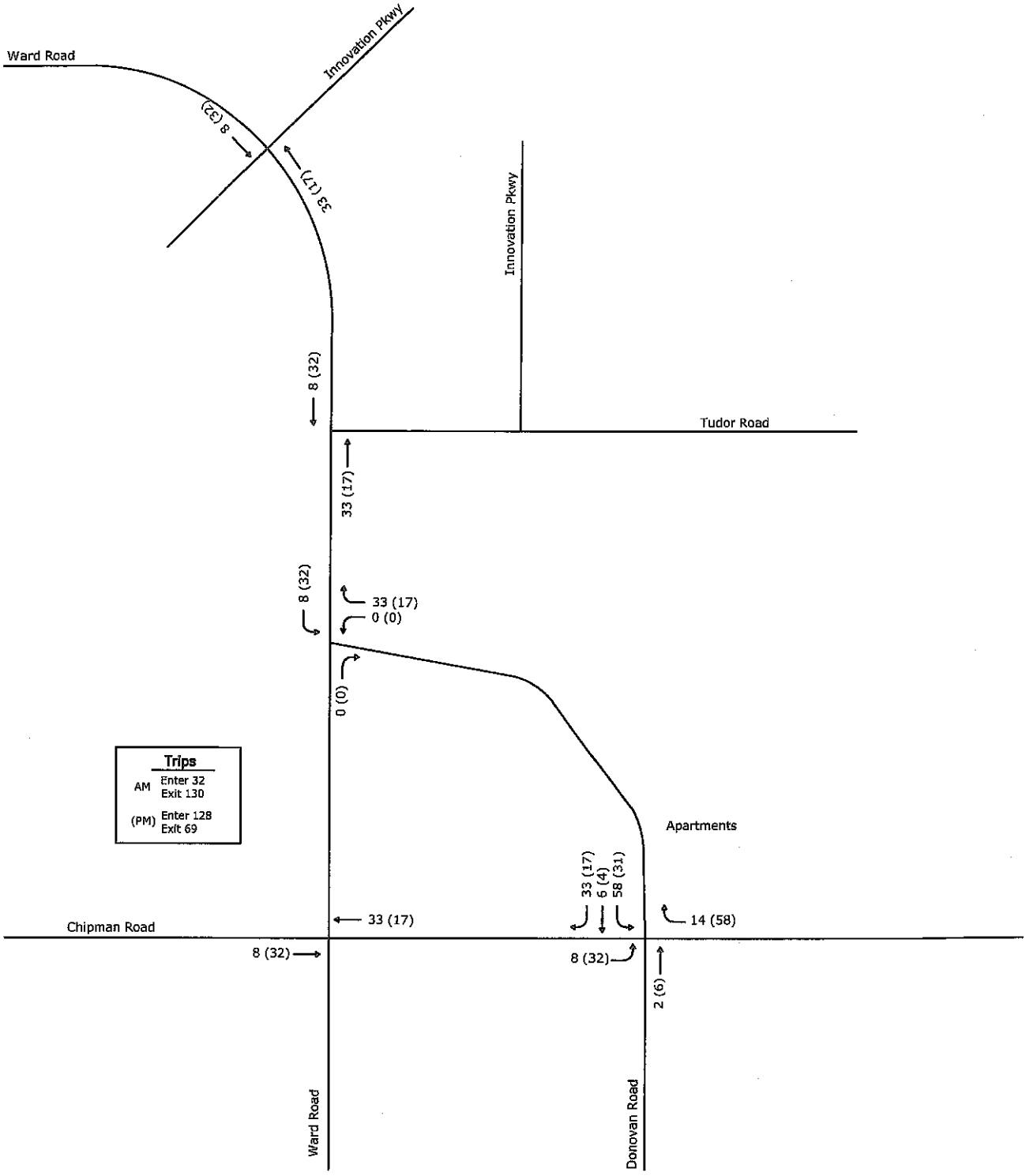
Appendix F: Trip Generation Distributions



McCLURE™
building strong

Distribution Percentages
Apartments, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

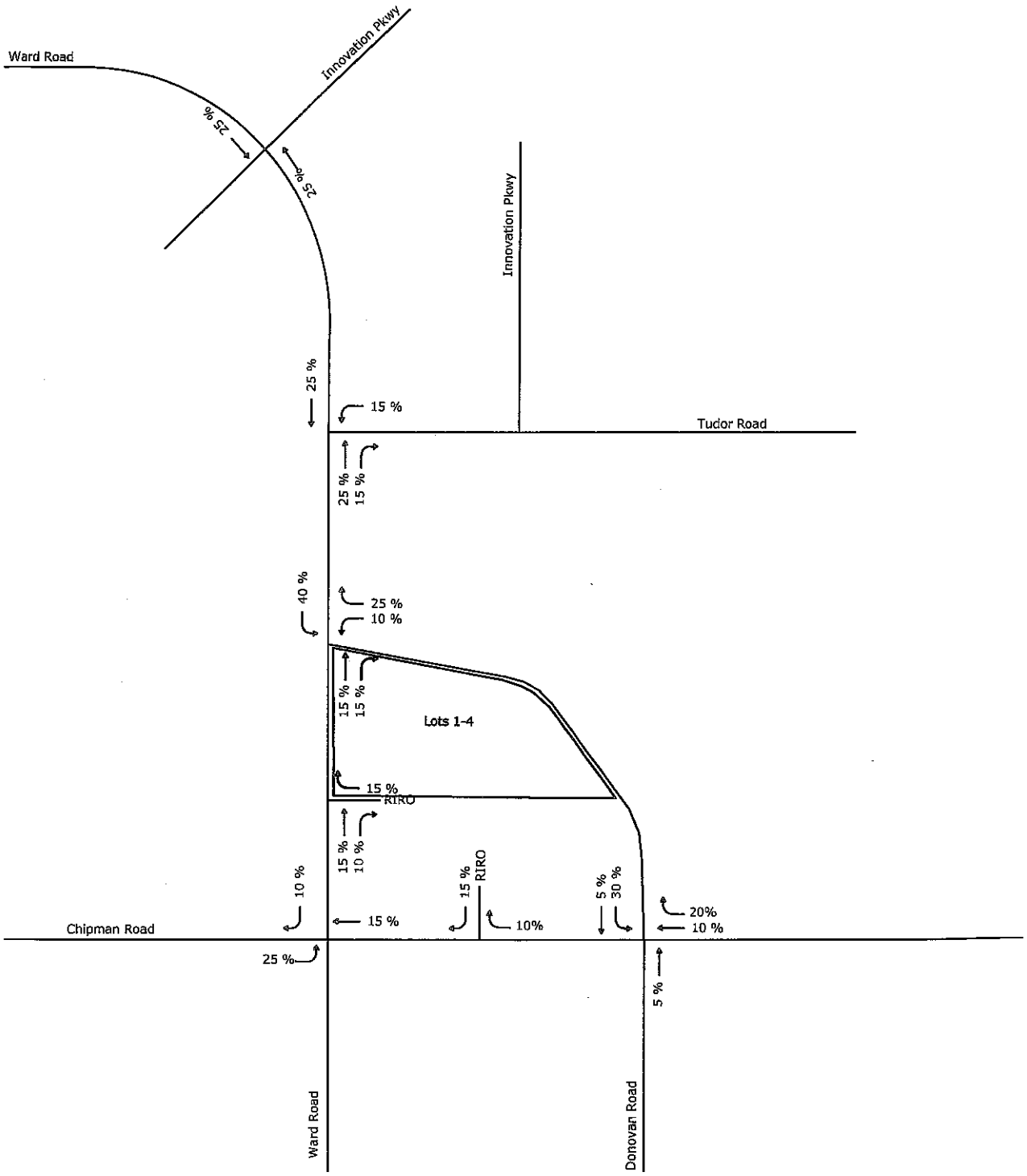
NORTH



McCLURE
building strong

Trip Distribution
Apartments, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

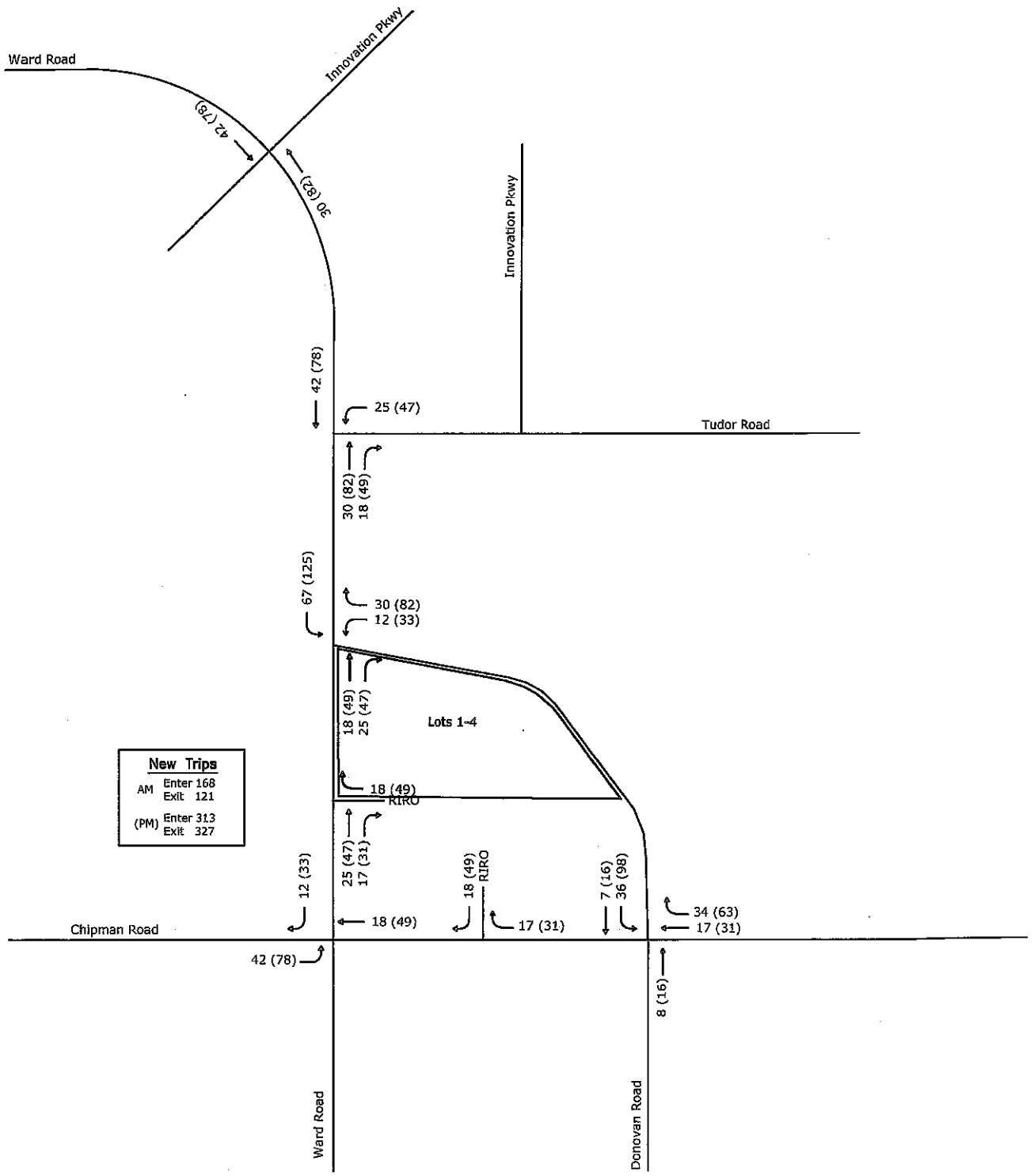
NORTH



McCLURE
building strong

Distribution Percentages
Lots 1-4 Commercial, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

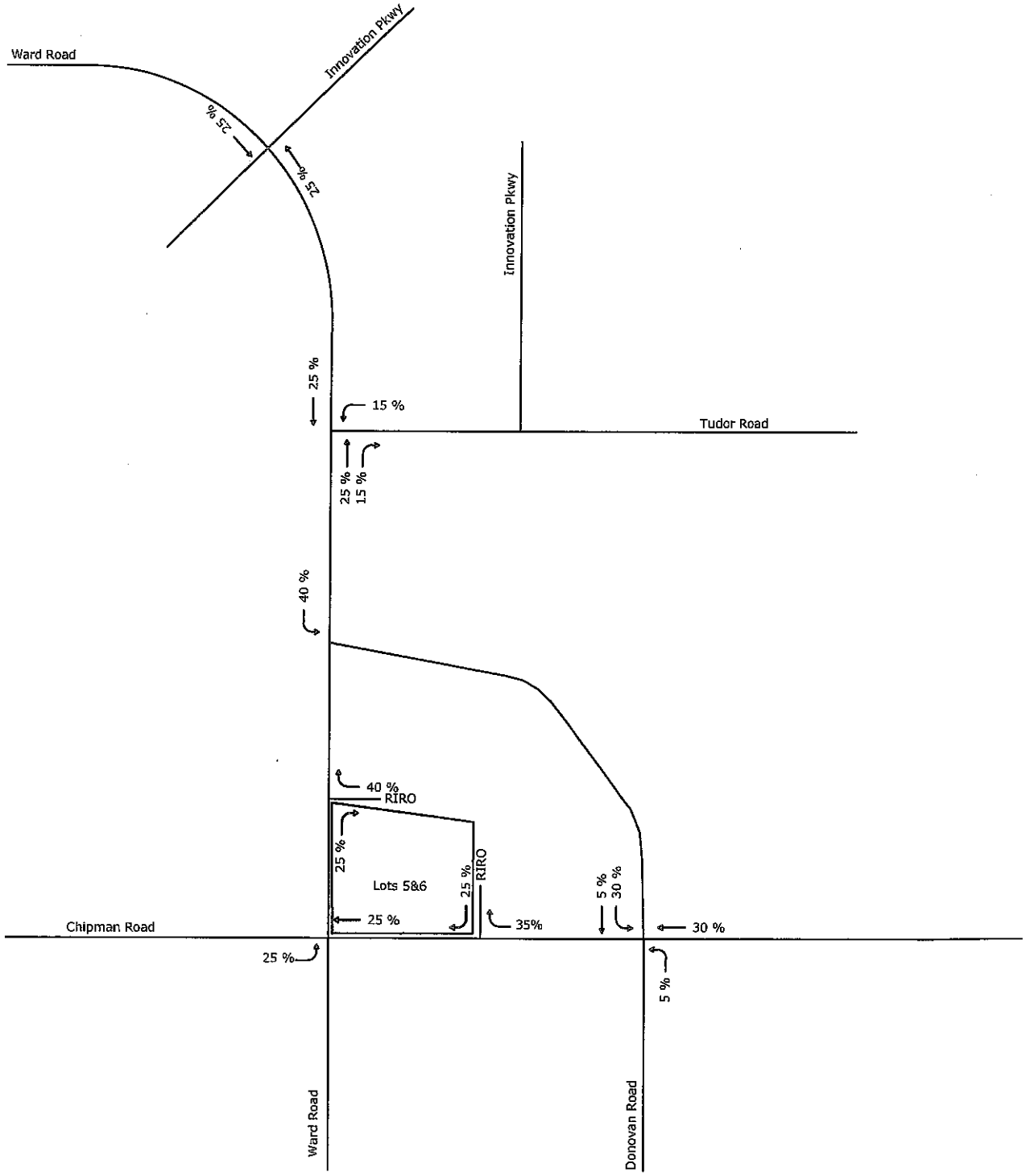
NORTH



McCLURE
building strong

New Trips Distribution
Lots 1-4 Commercial, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

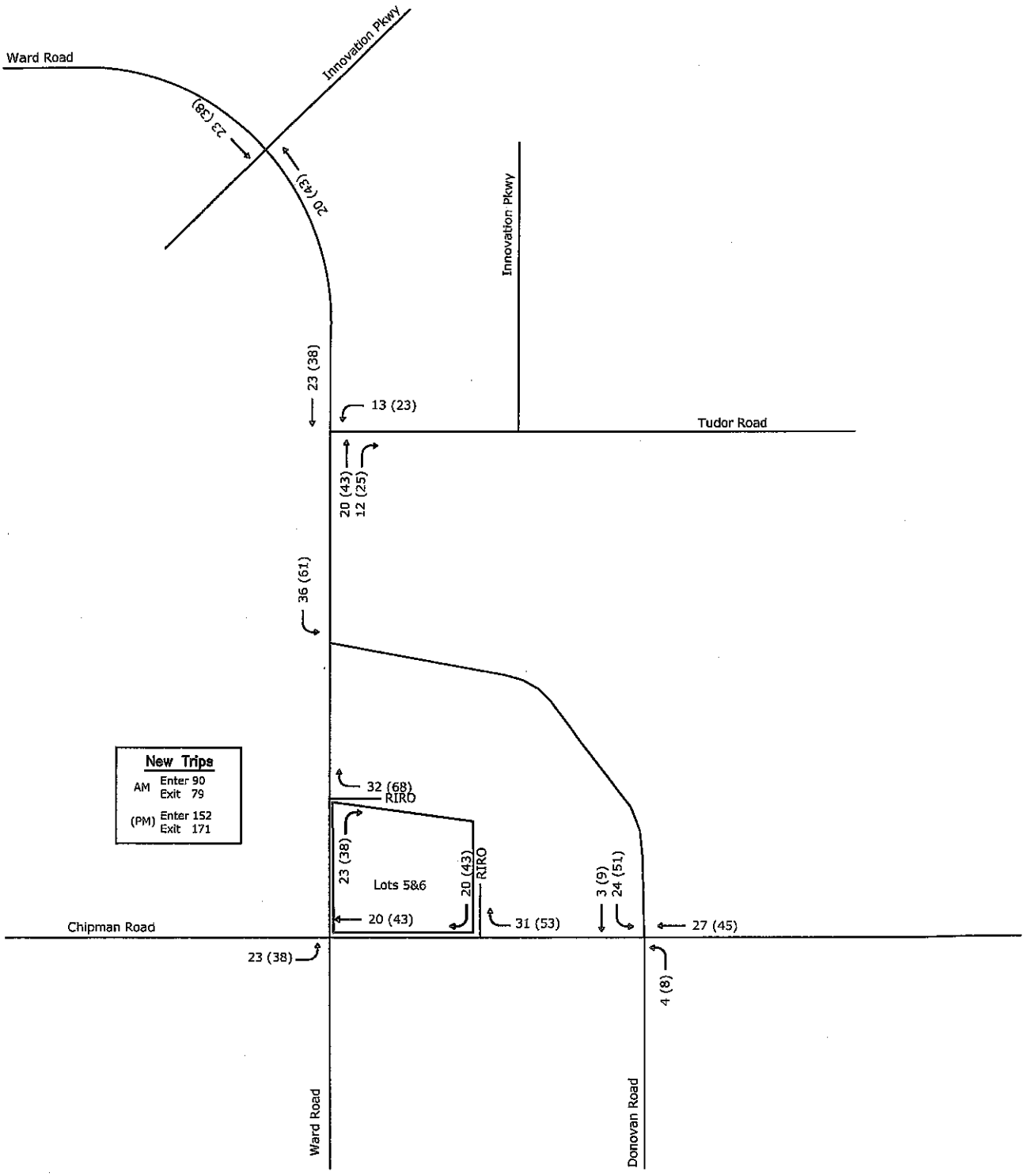
NORTH



McCLURE™
building strong

Distribution Percentages
Lots 5&6 Commercial, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

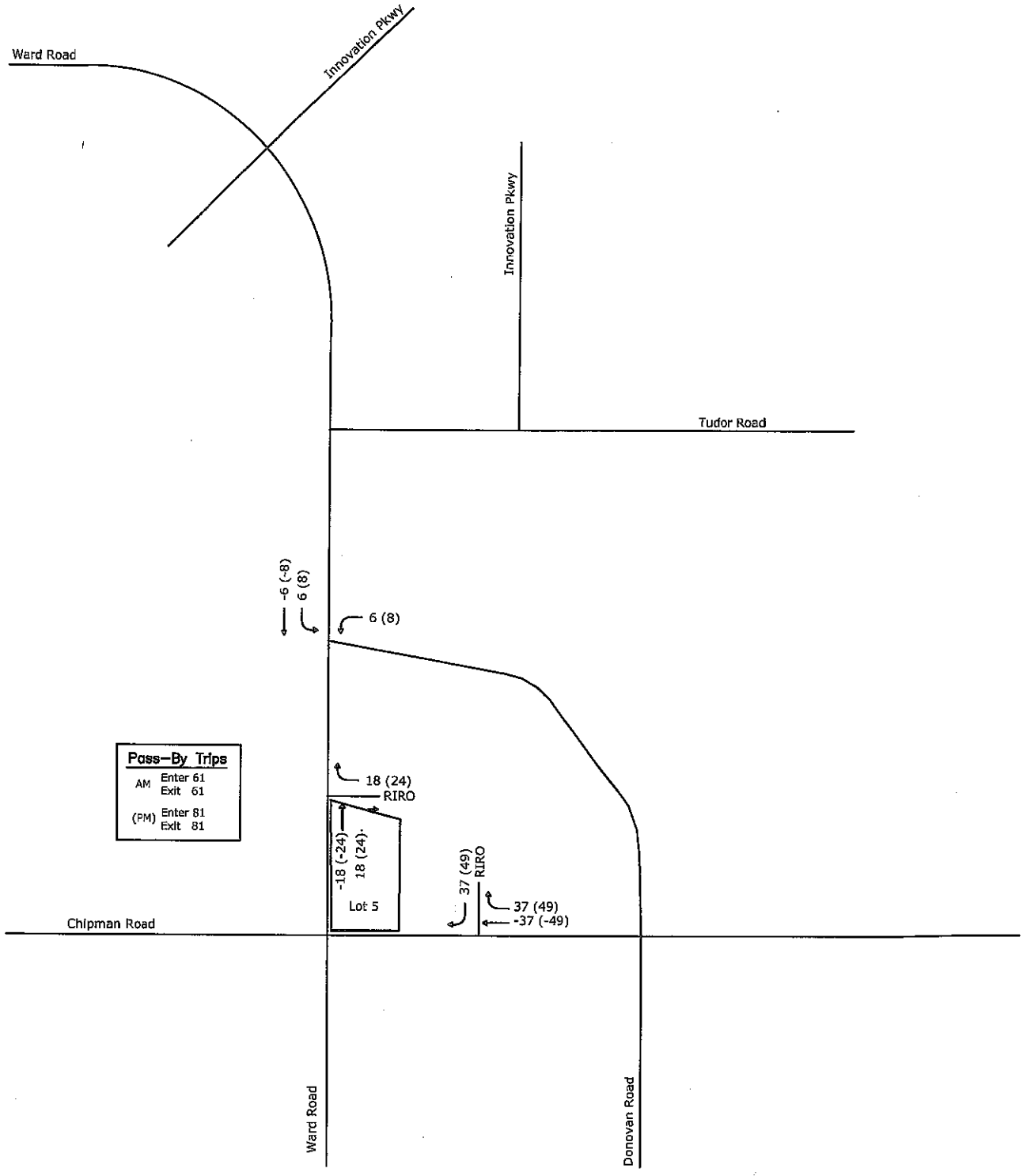
NORTH



McCLURE
building strong

New Trips Distribution
Lots 5&6 Commercial, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

NORTH



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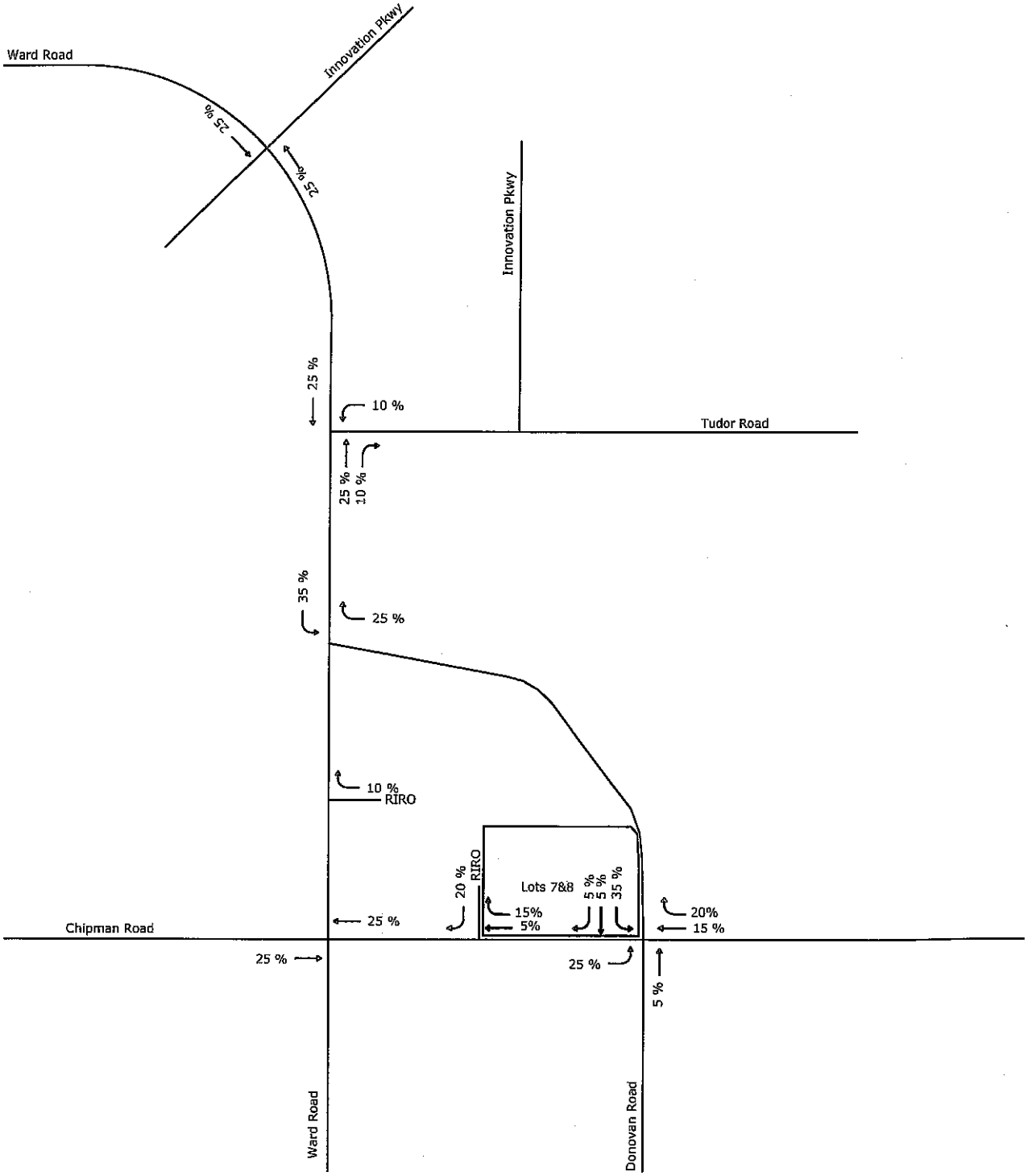
Pass-By Trips
Lot 5 Commercial, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

NORTH



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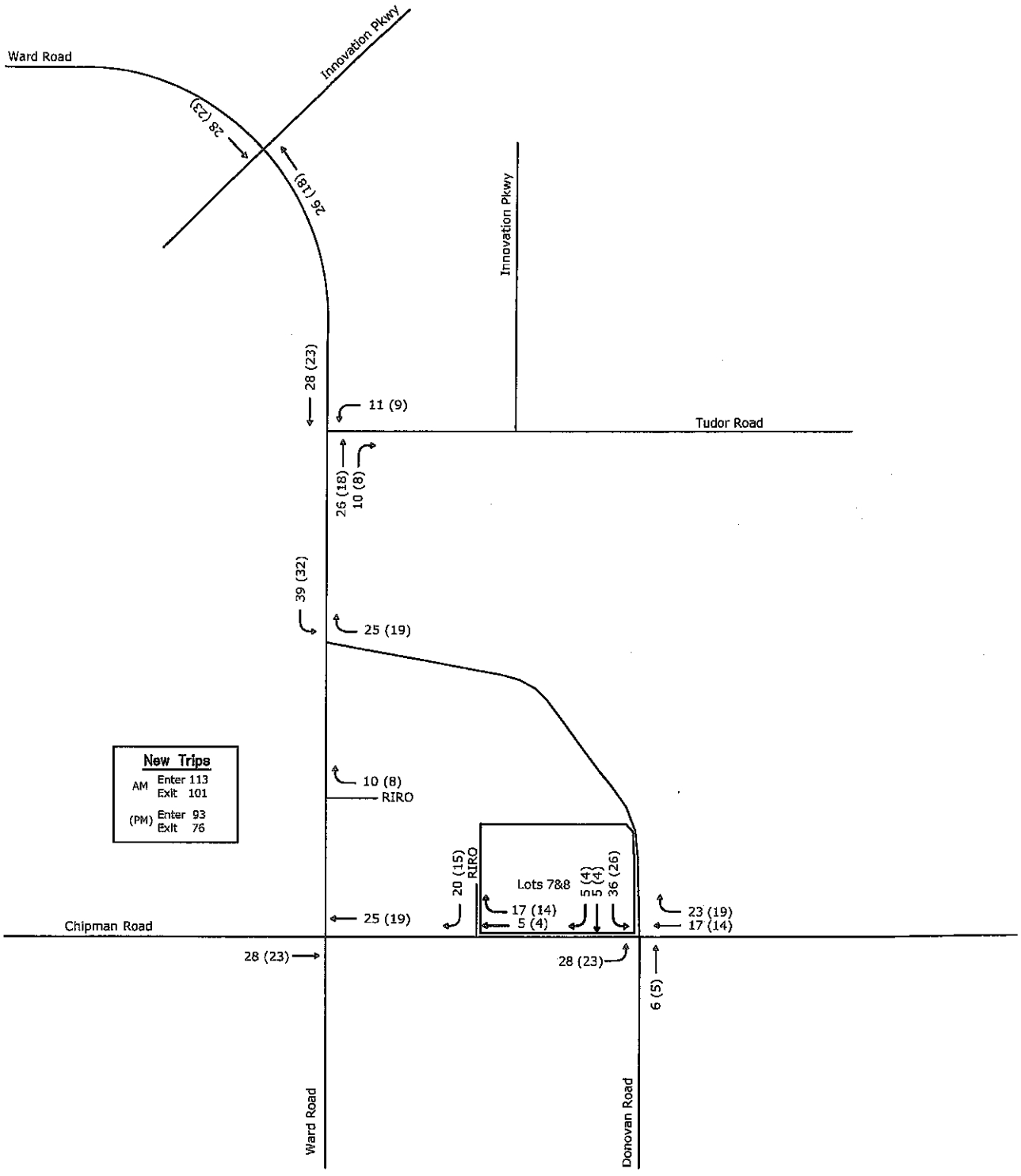
Distribution Percentages
Lots 7&8 Commercial, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

NORTH



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New Trips Distribution
Lots 7&8 Commercial, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

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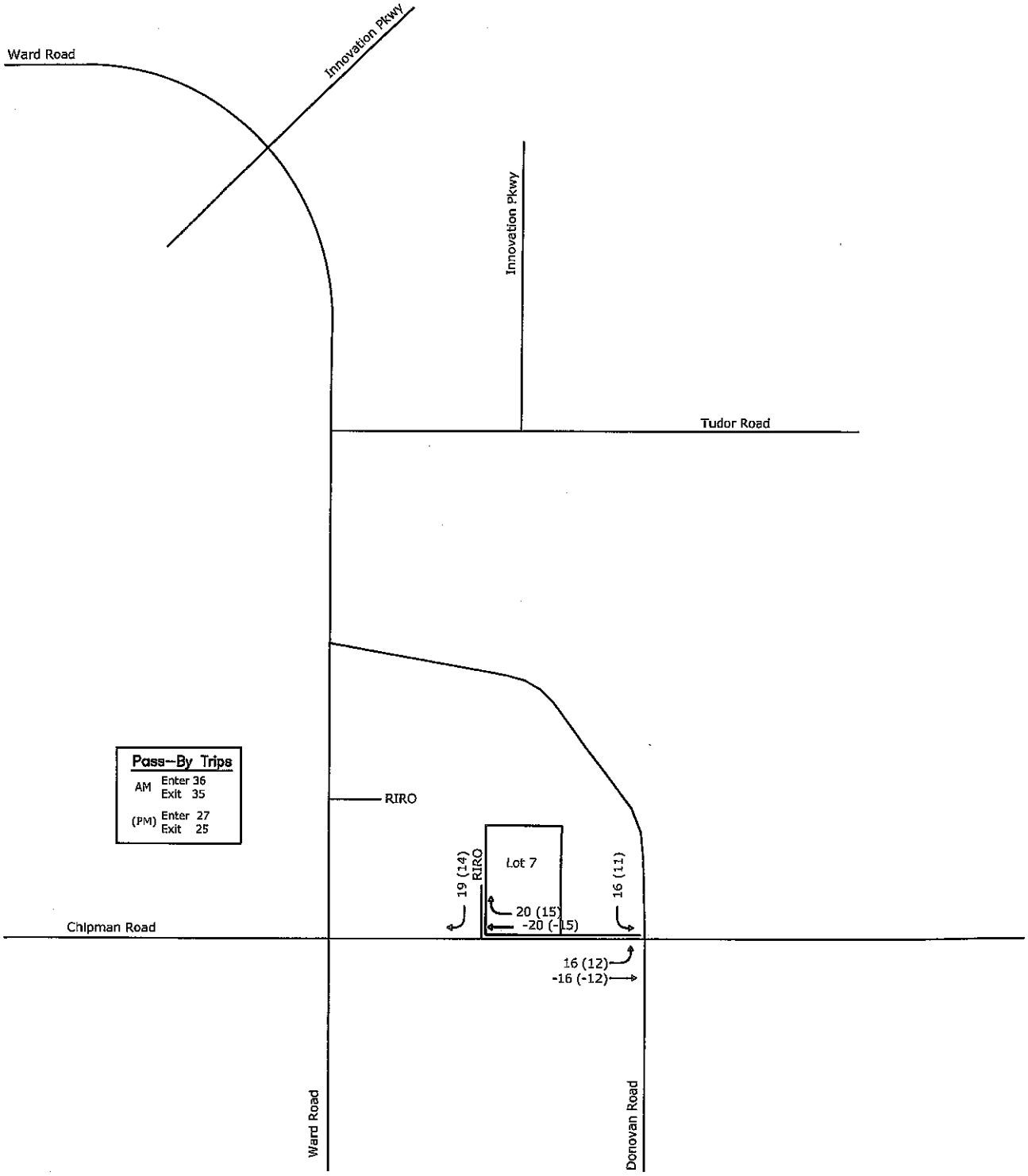

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Pass-By Trips
Lot 7 Commercial, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

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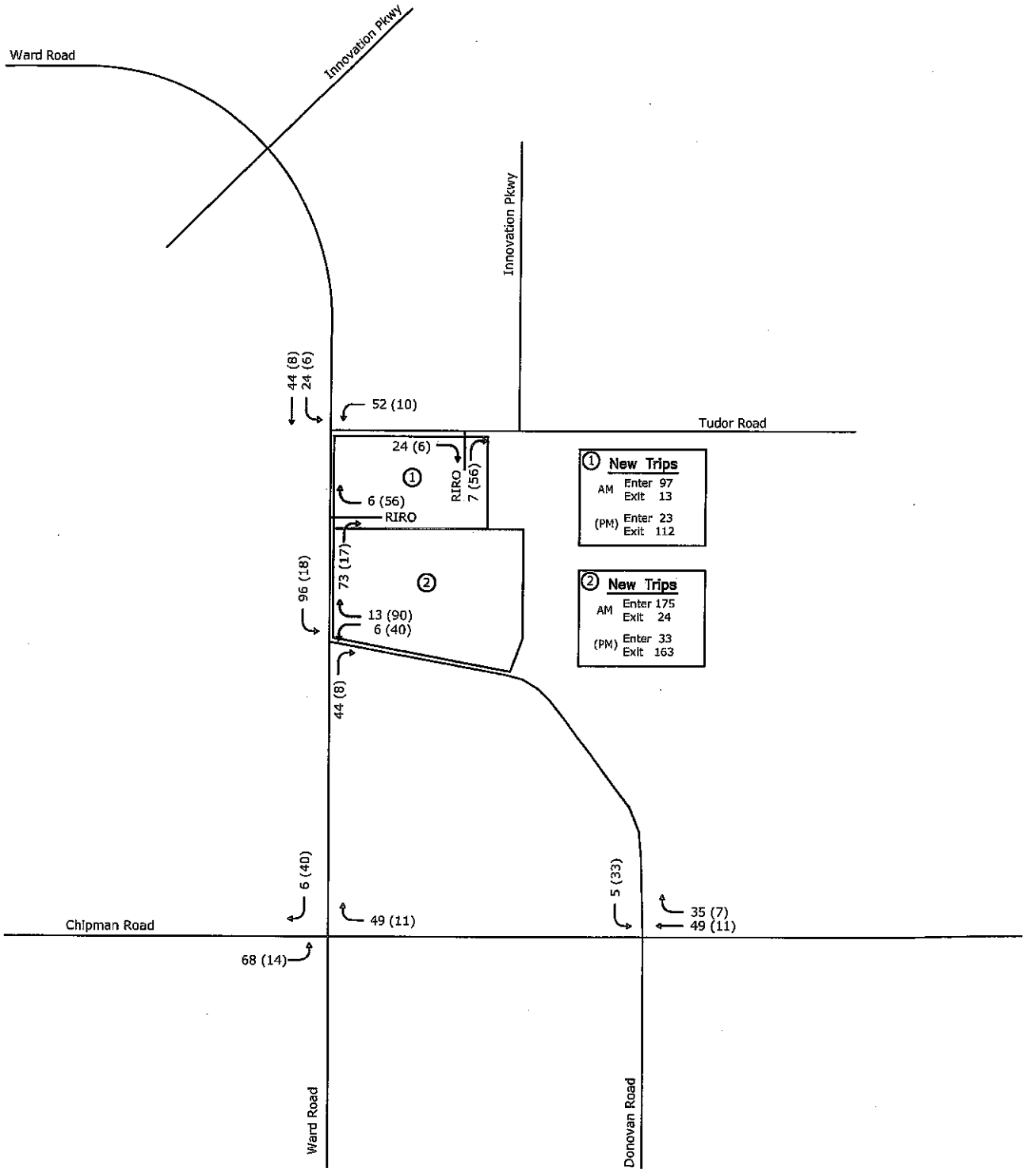

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New Trips Distribution
Office Bldgs, Summit Orchards
Traffic Impact Study
Lee's Summit, MO

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