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Comprehensive Traffic Study at Delmar & I-170

Traffic Study

University City, Missouri

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Executive Summary

Lochmueller Group has prepared the following comprehensive traffic study for the City of University City in the vicinity of the interchange of Interstate 170 (I-170) and Delmar Boulevard. The intent of this comprehensive study is to identify the traffic improvements necessary to accommodate various development proposals currently under consideration with the City and identify the relative responsibility for each of the redevelopment proposals to provide identified infrastructure improvements, if necessary. The three developments currently under consideration by the City are:

- Delcrest Plaza Development
- Delmar Mixed Use Development
- Crown Center Development

This study will forecast the amount of traffic that would be generated by the three currently proposed developments, evaluate the impact of the additional trips on the study area road system with respect to each development, evaluate the impact of the additional trips on the study area road system when all three developments are complete, and determine if roadway or traffic improvements would be recommended to mitigate the development's impacts and the relative responsibility of each development to provide such improvements. The following scenarios are evaluated:

- 2020 Existing Conditions
- 2020 Existing + Delcrest Plaza Traffic Conditions
- 2020 Existing + Delmar Mixed Use Traffic Conditions
- 2020 Existing + All Developments Traffic Conditions
- 2040 Horizon Baseline Traffic Conditions
- 2040 Horizon Buildout Traffic Conditions (Including all 3 Developments)

Given the nature of the redevelopments, the traffic impact study focuses on the morning and afternoon peak periods of a typical weekday.

Based upon the analysis of these scenarios, the following conclusions were reached:

- Existing Conditions:
    - Currently, the study intersections generally have favorable conditions during both peak periods with the exception of Delmar Boulevard at the Northbound and Southbound I-170 Ramps. These intersections experience failing, or near failing, levels of service in existing conditions.
    - From an access management perspective, it is undesirable how close the intersection of Ladue Crossing Access Road to Delmar Boulevard is to the signalized intersection with the Northbound I-170 Ramps. Left turns from the Ladue Crossing Access Road results in not only traffic operational issues given the lack of adequate space between the intersections, but it also poses a safety issue given the potential for westbound queues to extend past

Ladue Crossing Access Drive and the existing eastbound left turn lane on Delmar Boulevard serving the retail center in the northeast quadrant of the intersection. However, this intersection has been in place for many years and a time-based restriction is in place which prohibits left-turns from 4:00-6:00 PM Mondays-Fridays. It is recommended that the intersection be monitored during the PM peak period to ensure enforcement of the time based no left-turn restriction.

- Delcrest Plaza Development:
  - The Delcrest Plaza development includes a 133-room hotel, a 285-unit apartment building, and 4,000 SF of retail/restaurant space.
  - Primary access is provided via one full access driveway on Delcrest Drive, approximately 290 feet south of Delmar Boulevard. A pick-up/drop-off loop is proposed off Delcrest Drive. Trash and other service vehicles would access the site via a new curb cut along Ladue Crossing Access Road, which would not be accessible to the public. The proposed development plans to remove the two existing full access curb cuts along Delmar Boulevard.
  - The proposed Delcrest Plaza development would generate a total of approximately 210 and 245 trips during the weekday morning and evening peak hours, respectively.
  - 2020 operating conditions with only the Delcrest Plaza Development in place show that the study intersections are expected to operate favorably with results similar to the existing conditions. The newly proposed site driveway on Delcrest Drive operates at a LOS C or better with queue lengths equal to one vehicle.
  - However, the intersections of Delmar Boulevard and the Northbound and Southbound I-170 Ramps continue to experience failing levels of service, comparable to existing conditions. It is LochGroup's opinion that improvements to this intersection would not be the sole responsibility of this development as this intersection is nearing failing levels of service during existing conditions and the development would add a minimal amount of traffic to the intersections.
  - The proposed access drive onto Delcrest Drive's separation relative to the Walgreen's access drive is not identified on the provided site development plan or within CBB's study. It would be prudent to know the separation between these two drives to ensure that there would be no turning conflicts and that the opposing drives would function as "one" intersection.
  - Additionally, dimensions were not provided for the pick-up/drop-off loop proposed along Delcrest Drive. It would be prudent to know the dimensions of the proposed pick-up/drop-off loop to ensure maneuverability; thereby minimizing the potential for spillbacks onto Delcrest Drive. It is recommended that the loop be designed to provide for a bypass lane to ensure that vehicles can maneuver around one another.
  - The proposed service access on Ladue Crossing Access Road does not appear to meet sight distance requirements per the American Association of State Highway Transportation Officials (AASHTO). Currently, the fence on the Crown Center property is contributing to the limited sight distance. It is recommended that the petitioner's

engineer provide sight distance calculations/diagrams for the ultimate proposed location prior to issuance of a permit.

- **Overall, no mitigation as a result of Delcrest Plaza was recommended.**

- Delmar Mixed Use Development:
  - The development is to include approximately 258 apartment units with integrated structured parking and a separate 2,098 SF coffee shop with drive-through service.
  - Primary access is proposed via two new full-access driveways on Delmar Boulevard. As part of the development plan, McKnight Place would be realigned to remove the slight curve in the roadway approaching Delmar Boulevard.
  - The proposed Delmar Mixed Use development would generate a total of approximately 185 and 155 new trips during the weekday morning and evening peak hours, respectively.
  - 2020 operating conditions with the Delmar Mixed Use Development in place show that the study intersections are expected to operate favorably with results similar to the existing conditions. The newly proposed site driveways on Delmar Boulevard operate at a LOS C or better with queue lengths equal to one vehicle or less.
  - However, the intersections of Delmar Boulevard and the Northbound and Southbound I-170 Ramps continue to experience failing levels of service, comparable to existing conditions. It is LochGroup's opinion that improvements to this intersection would not be the sole responsibility of this development as this intersection is nearing failing levels of service during existing conditions and the impact associated with the development does not significantly degrade these conditions further.
  - The addition of a two-way left-turn lane along Delmar Boulevard adjacent to the development significantly improves conditions along the northbound approach at Delmar Boulevard and McKnight Place. **For this reason, LochGroup agrees with CBB's recommendation of a two-way left-turn lane between McKnight Place and the newly proposed Delmar Apartments Main Entrance to the west of the site. This improvement should be the responsibility of the Delmar Mixed Use Development.**
  - The proposed site plan does not provide cross access to the existing Gatesworth Community. Cross access is vital as tenants of the Gatesworth Community should be able to access the proposed coffee shop without having to rely upon Delmar Boulevard and thereby add unnecessary turning movements. **LochGroup recommends providing cross access between the site and the Gatesworth community in order to improve access and circulation.**
  - All proposed intersections along Delmar Boulevard should conform to the sight distance requirements set forth by the American Association of State Highway and Transportation Officials (ASHTO). Furthermore, as part of the design process, care should be given to ensure that signage and/or landscaping does not pose sight distance limitations at any of the proposed drive locations.
  - **The proposed Delmar Mixed-Use development, in and of itself, does not significantly impact traffic operations along the surrounding road network. Other than the provision of a two-way left-turn lane between McKnight Place and the newly proposed Delmar**

Apartments Main Entrance to the west of the site, and the provision of cross access to the Gatesworth Community no additional mitigation as a result of the Delmar Mixed Use Development was recommended.

- Crown Center Development:
    - Currently, the Crown Center has an existing 244-unit multi-family residential development for senior living with associated accessory services on site. Therefore, the "redevelopment" would essentially be an update to the existing facilities without changing the use, significantly modifying the number of units provided, or the site's access. **Therefore, the redevelopment of Crown Center would not contribute any additional traffic to the surrounding road system as it is already captured in the existing conditions.**

- 2020 and 2040 Comprehensive Analysis:
    - Many of the study intersections would continue to operate with satisfactory levels of service and manageable delays. All newly proposed site access driveways for the Delcrest Plaza Development and Delmar Mixed Use Development are expected to operate favorably with a LOS C or better for both peak hours.
    - Overall, neither the Delcrest Plaza development nor the Delmar Mixed Use development appear to significantly impact traffic operations throughout the study area. Levels of service are mostly maintained, with queue lengths at unsignalized intersections limited to approximately two vehicles.
    - Again, the northbound and southbound I-170 Ramps operate unfavorably. However, conditions under the "comprehensive" analysis are not significantly worse than those under the existing conditions. **Therefore, it does not appear that there is a need for any of the development proposals to mitigate traffic conditions beyond those improvements individually prescribed for each development.**

While mitigation recommendations at both the Northbound and Southbound I-170 Ramps at Delmar Boulevard may not be attributable to the developments under consideration in this study, as the area continues to develop and additional traffic is introduced, it will be necessary to provide additional relief to the road network. LochGroup offers the following recommendations for consideration:

1. Encourage multi-modal use to improve accommodations for non-vehicle modes and help offset impact of developments. University City is prime for multi-modal use with easy access to transit and Centennial Greenway.

2. Enforce the existing northbound left turn restriction on the Ladue Crossing Access Drive's approach to Delmar Boulevard during the weekday PM peak period (4 to 6 PM, Monday thru Friday). The issuance of tickets to offenders should curb the current violation of this restriction and therefore improve operations and safety. Should the use of enforcement prove ineffective, then it is suggested that St. Louis County Department of Transportation enter into discussions

with the owner of this private road to consider the installation of a median that would limit left turns.

3. Consider a reallocation of the traffic signals' green time to provide additional time to the off ramps. A progression analysis of the signalized intersections along Delmar Boulevard may prove beneficial.

4. Consider the addition of a third lane to the southbound approach to Delmar Boulevard of the I-170 Southbound off ramp. The proposed lane configuration would be two dedicated left-turn lanes and one shared through/right-turn lane. This improvement would decrease the queue at the southbound approach by approximately 100 ft (4 vehicle lengths) and the volume to capacity ratio is decreased by approximately 14% during the 2020 comprehensive conditions.

5. Widen the northbound approach at Delmar Boulevard and the I-170 Northbound Ramps to provide a dedicated left-turn lane, a dedicated through lane, and a channelized right-turn lane. This improvement decreases the queue at the southbound approach by approximately 160 ft (6 vehicle lengths) and the volume to capacity ratio is decreased by approximately 19% during the 2020 comprehensive conditions.

6. Evaluate the feasibility of providing a third lane to the southbound approach to Delmar Boulevard from McKnight Road opposite the I-170 Northbound off ramp. The proposed lane configuration would be two dedicated left-turn lanes and one right-turn lane. Additionally, split phasing would be required with the lane configuration. This improvement, if proved to be physically possible, would decrease the queue at the southbound approach by approximately 150 ft (6 vehicle lengths) and the volume to capacity ratio is decreased by approximately 32% during the 2020 comprehensive conditions. It should be noted that the close proximity to the signalized intersection to the north, coupled with the right-of-way limitations constrains the width in which to accomplish this improvement. For those reasons, this proposed modification may not be feasible.

7. **Given that both the northbound and southbound I-170 off ramps experience failing levels of service with volumes at or approaching capacity, it stands to reason that this interchange may be a candidate for a new configuration in the long term. LochGroup recommends that further study be completed that contemplates various interchange configurations that could serve Delmar Boulevard and McKnight Road in order to mediate these conditions and provide a long term solution to the constrained operating conditions at this interchange.**

The following report outlines in detail the methodology and analysis that supports the above conclusions.

Introduction

Lochmueller Group has prepared the following comprehensive traffic study for the City of University City in the vicinity of the interchange of Interstate 170 (I-170) and Delmar Boulevard. The intent of this comprehensive study is to provide an independent review to identify the traffic improvements necessary to accommodate various development proposals currently under consideration with the City and identify the relative responsibility for each of the redevelopment proposals to provide identified infrastructure improvements. The three developments currently under consideration by the City are:

- Delcrest Plaza Development
- Delmar Mixed Use Development
- Crown Center Development

Figure 1 depicts the study area and all three developments that are under consideration.

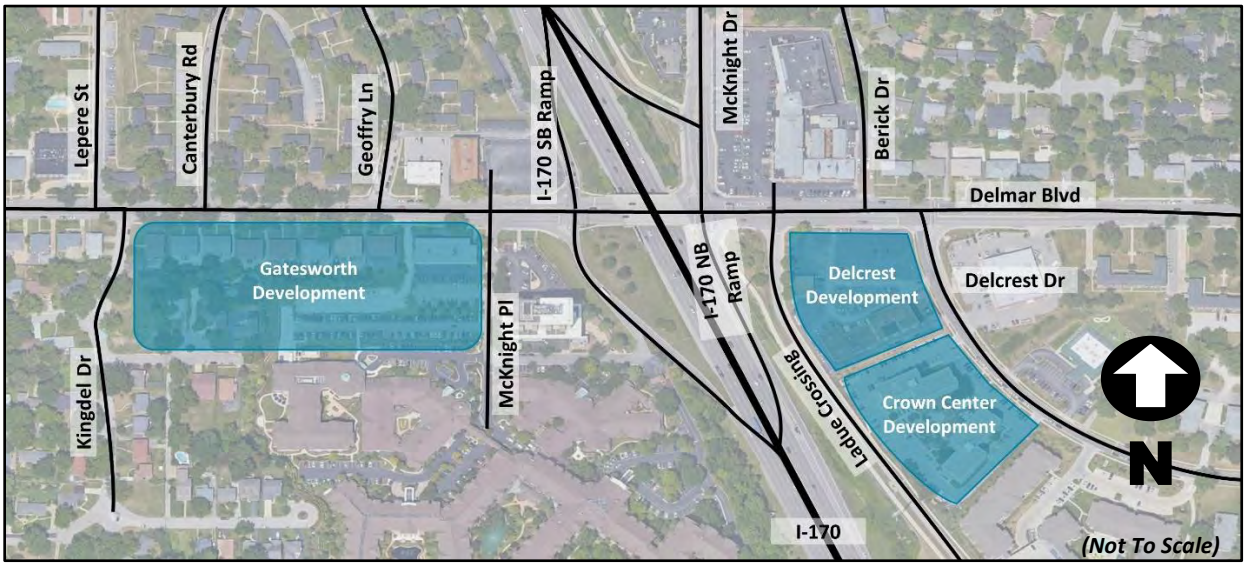

Figure 1. Location of Proposed Redevelopments

Delcrest Plaza is located at 8400 Delmar Boulevard in the southeast quadrant of the interchange and would be a redevelopment opportunity for a currently underutilized property. It is anticipated that, once redeveloped, that Delcrest Plaza would provide a 133-room hotel, a 285-unit apartment building, and 4,000 SF of retail/restaurant space. As shown, primary access is provided via one full access driveway on Delcrest Drive, approximately 290 feet south of Delmar Boulevard. A pick-up/drop-off loop is also proposed along Delcrest Drive. Trash and other service vehicles would access the site via a new curb cut along Ladue Crossing Access Road, which would not be accessible to the public. The proposed development plans to remove the two existing full access curb cuts along Delmar Boulevard.

West of I-170, the proposed Delmar Mixed Use development would be constructed immediately west of the existing Gatesworth community. The development is to include approximately 258 apartment units with integrated structured parking and a separate 2,098 SF coffee shop with drive-through service.

Primary access is proposed via two new full-access driveways on Delmar Boulevard. As part of the development plan, McKnight Place would be realigned to remove the slight curve in the roadway near Delmar Boulevard.

Lastly, the third redevelopment is the Crown Center site, which is located in the southeast quadrant of the interchange, immediately south of the Delcrest Plaza redevelopment. The redevelopment of the Crown Center site, located at 8348-8350 Delcrest Drive, has filed a one-year extension for their previously approved Amended Final Development Plan. This redevelopment includes the construction of a 238-unit multi-family residential development for senior living with associated accessory uses. Currently, the Crown Center has an existing 244-unit multi-family residential development for senior living with associated accessory services on site. Therefore, the "redevelopment" would essentially be an update to the existing facilities without changing the use, significantly modifying the number of units provided, or the site's access.

In order to assess each redevelopment's individual impacts on the surrounding road, as well as their cumulative impacts, the following scenarios are evaluated in this study:

- 2020 Existing Conditions
- 2020 Existing + Delcrest Plaza Traffic Conditions
- 2020 Existing + Delmar Mixed Use Traffic Conditions
- 2020 Existing + 3 Developments Traffic Conditions
- 2040 Horizon Baseline Traffic Conditions
- 2040 Horizon Buildout Traffic Conditions (Including all 3 Developments)

This study will forecast the amount of traffic that would be generated by the three currently proposed developments, evaluate the impact of the additional trips on the study area road system with respect to each development, evaluate the impact of the additional trips on the study area road system when all three developments are complete, and determine if roadway or traffic improvements would be recommended to mitigate the development's impacts and the relative responsibility of each development to provide such improvements.

Conditions were evaluated during the morning and evening peak periods for a typical weekday since these periods represent the busiest times for the adjacent roadways as well as the proposed uses. If the proposed redevelopments' traffic can be accommodated during these peak periods, it stands to reason that adequate capacity would be available throughout the remainder of the day.

2020 Existing Conditions

To identify the traffic impacts associated with the proposed redevelopment, it was first necessary to quantify roadway, traffic, and operating conditions as they currently exist.

Existing Roadway Network

The study area road system was inventoried to identify existing roadway types, lane configuration, functional classifications, posted speeds, access provisions, and intersection control. The traffic data was collected at the following intersections:

- Delmar Boulevard & Lepere Street/Kingdel Drive (unsignalized)
- Delmar Boulevard & Canterbury Road (unsignalized, One-Way Southbound)
- Delmar Boulevard & Geoffry Lane (unsignalized, One-Way Northbound)
- Delmar Boulevard & McKnight Place (unsignalized)
- Delmar Boulevard & I-170 Southbound Ramps (signalized)
- Delmar Boulevard & I-170 Northbound Ramps/McKnight Road (signalized)
- Delmar Boulevard & Ladue Crossing Access Road (unsignalized)
- Delmar Boulevard & Berick Drive (unsignalized)
- Delmar Boulevard & Delcrest Drive (signalized)
- Delmar Boulevard & Old Bonhomme (signalized)
- McKnight Road & I-170 On-Ramp (signalized)

North and Southbound I-170 Ramps allow traffic to enter and exit I-170 at Delmar Boulevard and McKnight Road via a modified traditional diamond interchange configuration. The modification is that the northbound on ramp is accessed via McKnight Road approximately 220 feet to the north of Delmar Boulevard rather than the traditional location opposite the northbound off ramp. All three of the intersections providing access to I-170 are signalized. Each of the ramps are under the jurisdiction of the Missouri Department of Transportation (MoDOT).

The northbound off ramp from I-170 to Delmar Boulevard has dedicated left-turn, through, and right-turn lanes. The southbound approach of McKnight Road at this intersection has a dedicated right-turn lane and a dedicated left-turn lane. The westbound approach has two dedicated through lanes and a shared through/right-turn lane. The eastbound approach has a dedicated left-turn lane and two through lanes.

The southbound approach of the I-170 off ramp to Delmar Boulevard is comprised of a shared left-turn/through/right-turn lane and a dedicated left-turn lane. The westbound approach has two dedicated through lanes and a dedicated left-turn lane. The eastbound approach has three through lanes and a dedicated channelized right-turn lane. The south leg is comprised of the southbound on ramp to I-170.

See McKnight Road for discussion about the geometrics at the intersection with the I-170 northbound on ramp.

Delmar Boulevard within the study area is controlled by the Saint Louis County Department of Transportation (SLCDOT); which classifies the roadway as an arterial. However, per MoDOT's functional classification map for the region, the roadway is classified as a major collector west of I-170 and a minor arterial east of I-170. West of I-170, Delmar Boulevard narrows to two lanes with one lane in each direction. Dedicated street parking lanes are provided on both sides of Delmar Boulevard west of the I-170 interchange after McKnight Place. East of I-170, Delmar Boulevard is comprised of four lanes; two lanes in each direction and a two-way left-turn lane in the center. A parking lane is provided on the north side of Delmar Boulevard east of Delcrest Drive. Delmar Boulevard has a speed limit of 30 mph to the east of the I-170 interchange and 35 mph to the west of the I-170 interchange.

MetroBus serves McKnight Road and Delmar with the 33 – Midland line to the east of I-170. The site area was previously served along the north and south sides of Delmar on either side of I-170 by the 97 – Delmar Line. However, as of September 2019, the 97 – Delmar Line no longer serves areas west of North and South Road. Sidewalk is provided along both the north and south side of Delmar Boulevard and across I-170 as well. The Centennial Greenway crosses Delmar Boulevard on the east leg of its intersection with McKnight Road.

McKnight Road is also controlled by SLCDOT and is classified as a minor arterial. The intersection of McKnight Road and the I-170 northbound on ramp is signalized and is located 220 feet north of the signalized intersection with Delmar Boulevard. The northbound approach has a brief (approximately 115 feet) dedicated left-turn lane which provides access to northbound I-170 as well as a dedicated through lane. The southbound approach has a dedicated through lane and a shared through/right-turn lane which allows right-turning traffic to access northbound I-170. McKnight Road has a speed limit of 30 mph within the study area.

MetroBus serves McKnight Road with the 33 – Midland Line and has multiple stops along both the east and west side of McKnight Road. Sidewalk is provided along both the east and west side of McKnight Road. Centennial Greenway crosses McKnight Road on the north leg of the intersection.

Old Bonhomme Road is classified as a minor collector and is generally comprised of two lanes. The intersection of Delmar Boulevard and Old Bonhomme Road is a signalized intersection, located at the eastern end of the study area. The northbound approach has a dedicated left-turn lane and a shared through/right-turn lane. The southbound approach has a dedicated left-turn lane, a dedicated through lane, and a shared through/right-turn lane. The westbound and eastbound approaches have a dedicated left-turn lane, a dedicated through lane, and a shared through/right-turn lane. Sidewalks are provided on both sides of Old Bonhomme south of Delmar Boulevard; however, immediately north of Delmar Boulevard sidewalk is only provided on the west side of the road since parallel on street parking is provided along the east side adjacent to the retail shops. North of the commercial shops, the sidewalk begins on the east side as well.

Ladue Crossing Access Road runs parallel to I-170; immediately to the east (the Centennial Greenway runs between I-170 and Ladue Crossing Access Road). This roadway is private and serves as access to the Ladue

Crossing retail development to the south. Its approach to Delmar Boulevard is unsignalized and comprised of a single lane that serves both left and right turning traffic. There is a "No Left Turn" restriction in place from 4:00 to 6:00 PM Monday through Friday. The posted speed limit along this private roadway is listed at 20 mph. Sidewalk is provided along the east side of the roadway.

All other roads within the study area including Lepere Street, Kingdel Drive, Canterbury Road, Geoffry Lane, McKnight Place, Berick Drive, and Delcrest Drive are classified as local roads. Other than the western intersection of Delcrest Drive, each of the above local roads intersect with Delmar Boulevard at an unsignalized intersection. Traffic along the local roads is required to stop while traffic along Delmar Boulevard has the right-of-way. The intersection of Delmar Boulevard and Delcrest Drive (west intersection) is a signalized intersection.

The existing lane configuration and traffic control at the intersections included in the study area are depicted in **Figure 2.**

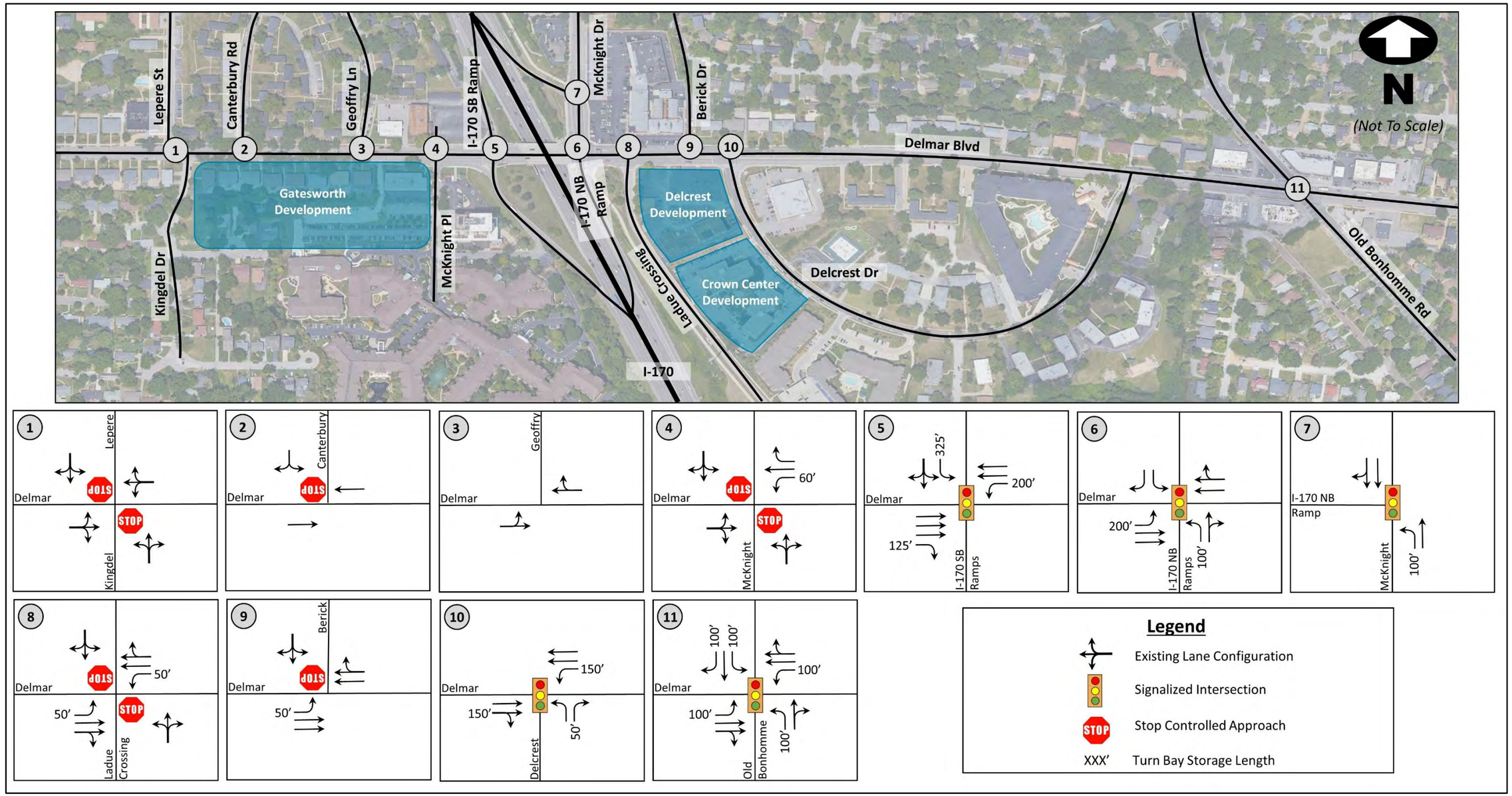

Figure 2. Existing Lane Configuration and Traffic Control

Pedestrian Accommodations

Centennial Greenway is a 17-mile greenway which serves bicycles and pedestrians. Centennial Greenway passes through the center of the study area along the east side of the Delmar Boulevard and I-170 interchange. Data pertaining to the pedestrian and cyclists crossing Delmar and McKnight via the Centennial Greenway were collected at the beginning of July 2020 and included in the model for the City's Comprehensive Traffic Study. There are no other dedicated bicycle facilities within the study area.

2020 Existing Traffic Volumes

The impacts of COVID-19 have rendered collecting data at this time unreliable. Therefore, current traffic counts were not collected. Another consultant, CBB, has previously completed traffic studies in the area and it was determined after a thorough review of their traffic studies that the existing counts presented in the *Traffic Impact Study for Proposed Mixed-Use Development at 8400 Delmar Boulevard*, dated July 23, 2020 in addition to the *Traffic Impact Study for Proposed Mixed-Use Development at Delmar Boulevard at McKnight Place* dated July 23, 2020 would serve as the basis for this comprehensive study. Furthermore, field observations by Lochmueller corroborated CBB's determination of the peak volumes and peak periods.

Based upon a review of the data, it was determined that the peak hours of traffic flow are 7:30 to 8:30 a.m. and 5:00 to 6:00 p.m. The existing traffic volumes are summarized in **Figure 3.**

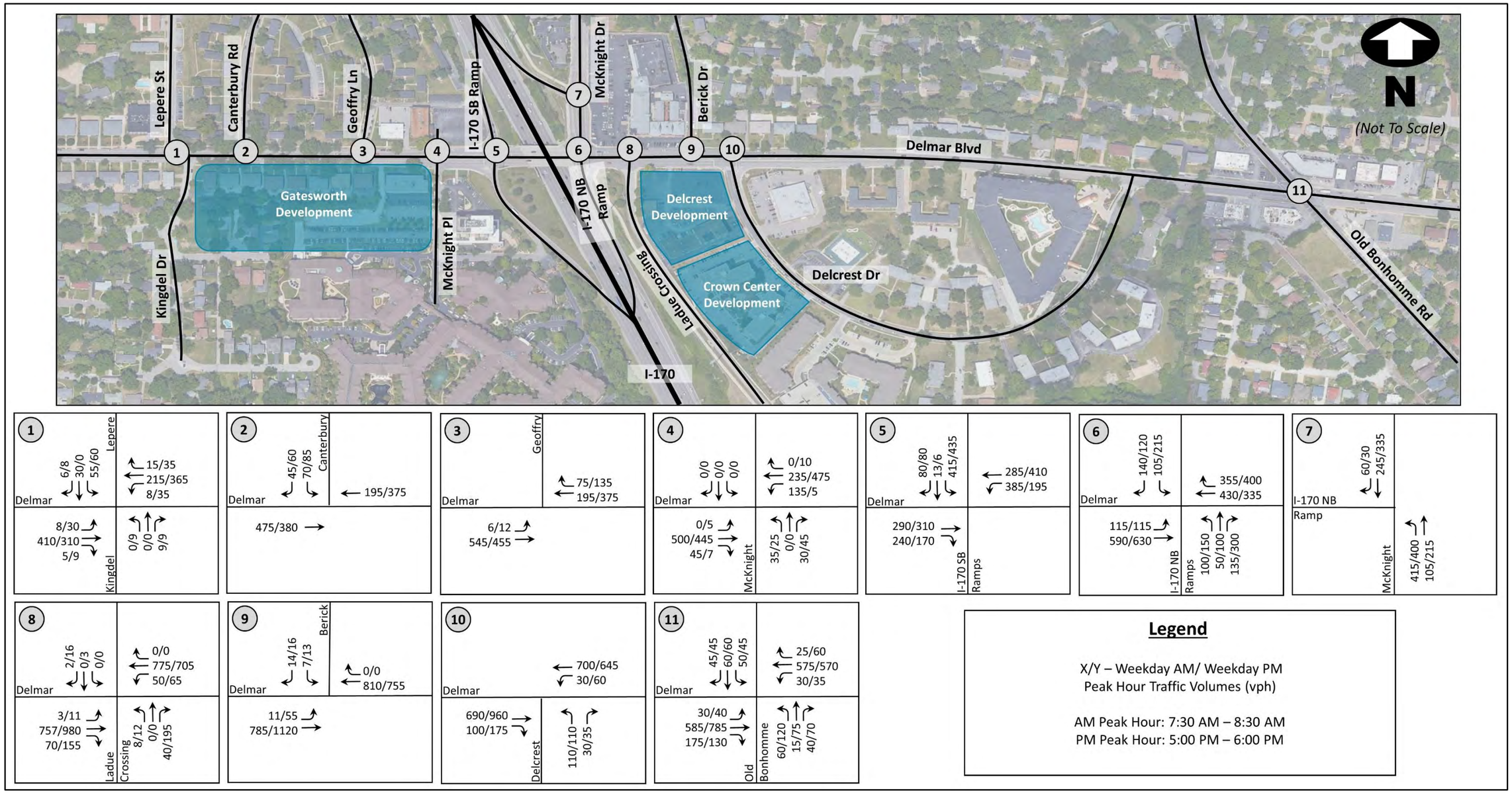

Figure 3. 2020 Existing Weekday Peak Hour Traffic Volumes

2020 Existing Operating Conditions

The existing traffic operating conditions at the critical study intersections were evaluated based upon the traffic volumes presented in Exhibit 3. The analysis was completed using Synchro 10 traffic modeling software, which is based upon the methodologies outlined in the "Highway Capacity Manual" (HCM) published by the Transportation Research Board.

Intersection performance or traffic operations are quantified by six Levels of Service (LOS), which range from LOS A ("Free Flow") to LOS F ("Fully Saturated"). LOS C is normally used for design purposes and represents a roadway with volumes ranging from 70% to 80% of its capacity. LOS D is generally considered acceptable for peak period conditions in urban and suburban areas and would be an appropriate benchmark of acceptable traffic for the study area road system.

Levels of service for intersections are determined based on the average delay experienced by motorists. Signalized intersections reflect higher delay tolerances as compared to unsignalized and roundabout locations because motorists are accustomed to and accepting of longer delays at signals. For signalized and all-way stop intersections, the average control delay per vehicle is estimated for each movement and then aggregated for each approach and the intersection as a whole. For intersections with partial (side-street) stop control, the delay is calculated for the minor movements only (side-street approaches and major road left-turns) since through traffic on the major road is not required to stop.

The thresholds for each level of service vary based upon the type of control to reflect different driver expectations. Signalized intersections are designed to carry higher traffic volumes, and therefore motorists accept heavier delays as compared to unsignalized intersections. **Table 1** summarizes the criterion for both signalized and unsignalized intersections, as defined by the HCM.

Table 1. Intersection Level of Service Thresholds

Level of Service	Control Delay per Vehicle (sec/veh)	
	Signalized	Unsignalized
A	≤ 10	0-10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	> 80	> 50

The existing operating conditions at the study intersections are summarized in **Table 2.** It should be noted that the Level of Service (LOS) and delay for unsignalized intersections are reported based upon HCM 6th Edition methodology, which is consistent with the Highway Capacity Manual (HCM) for signalized intersections.

Table 2. 2020 Existing Traffic Operating Conditions

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Lepere St/Kingdel Dr (unsignalized)		
Eastbound Left	A (7.8) [<25] <0.01>	A (8.3) [<25] <0.03>
Westbound Left	A (8.3) [<25] <0.01>	A (8.1) [<25] <0.03>
Northbound Approach	B (11.1) [<25] <0.02>	C (16.0) [<25] <0.06>
Southbound Approach	C (20.1) [30] <0.30>	C (25.4) [30] <0.30>
Delmar Blvd & Canterbury Rd (unsignalized, Side-Street STOP – One-Way Southbound)		
Southbound Approach	C (15.1) [28] <0.27>	C (19.0) [45] <0.39>
Delmar Blvd & Geoffry Ln (unsignalized, One-Way Northbound)		
Eastbound Left	A (0.1) [<25] <0.01>	A (0.4) [<25] <0.01>
Delmar Blvd & McKnight Pl (unsignalized, Side-Street, STOP)		
Eastbound Left	A (0.0) [<25] <0.00>	A (8.5) [<25] <0.01>
Westbound Left	A (9.4) [<25] <0.15>	A (8.4) [<25] <0.01>
Northbound Approach	D (27.7) [33] <0.31>	C (18.4) [<25] <0.23>
Southbound Approach	A (0.0) [<25] <0.00>	A (0.0) [<25] <0.00>
Delmar Blvd & I-170 Southbound Ramps (signalized)		
Overall Intersection	**C (22.8)**	**C (28.0)**
Eastbound Approach	B (13.1) [77] <0.33>	C (21.1) [91] <0.32>
Westbound Approach	B (10.1) [119] <0.55>	A (6.8) [68] <0.23>
Southbound Approach	D (48.8) [241] <0.77>	E (58.5) [#305] <0.84>
Delmar Blvd & I-170 Northbound Ramps/McKnight Rd (signalized)		
Overall Intersection	**B (17.9)**	**D (39.9)**
Eastbound Approach	A (4.2) [72] <0.37>	B (14.7) [288] <0.40>
Westbound Approach	B (18.1) [265] <0.54>	B (16.6) [188] <0.56>
Northbound Approach	C (30.0) [116] <0.72>	F (82.6) [#408] <1.09>
Southbound Approach	D (40.4) [125] <0.61>	E (77.1) [#244] <0.91>
McKnight Rd & I-170 On-Ramp (signalized)		
Overall Intersection	**A (6.8)**	**A (7.0)**
Northbound Approach	A (6.7) [354] <0.47>	A (6.5) [m280] <0.48>
Southbound Approach	A (7.1) [95] <0.14>	A (7.8) [118] <0.16>
Delmar Blvd & Ladue Crossing Access Rd (unsignalized –NBLT Prohibited in PM)		
Eastbound Left	A (9.6) [<25] <0.00>	A (9.2) [<25] <0.01>
Westbound Left	B (10.2) [<25] <0.07>	B (12.0) [<25] <0.12>
Northbound Approach	B (14.5) [<25] <0.14>	D (29.2) [110] <0.65>
Southbound Approach	B (11.2) [<25] <0.00>	C (15.1) [<25] <0.07>
Delmar Blvd & Berick Dr (unsignalized)		
Eastbound Left	A (9.8) [<25] <0.02>	A (9.8) [<25] <0.07>
Southbound Approach	B (14.3) [<25] <0.06>	C (16.6) [<25] <0.09>

Table 2 Continued. 2020 Existing Traffic Operating Conditions

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Delcrest Dr (signalized)		
Overall Intersection	**A (8.7)**	**B (10.4)**
Eastbound Approach	A (8.3) [170] <0.37>	B (11.4) [259] <0.55>
Westbound Approach	A (4.9) [100] <0.32>	A (4.3) [85] <0.28>
Northbound Approach	C (30.2) [96] <0.51>	C (33.7) [113] <0.51>
Delmar Blvd & Old Bonhomme Rd (signalized)		
Overall Intersection	**B (11.3)**	**B (16.5)**
Eastbound Approach	A (7.3) [150] <0.33>	B (11.2) [243] <0.44>
Westbound Approach	A (7.3) [126] <0.27>	B (10.3) [161] <0.34>
Northbound Approach	C (29.6) [68] <0.34>	D (43.0) [130] <0.69>
Southbound Approach	C (31.3) [79] <0.43>	C (25.1) [74] <0.28>

Delay presented in seconds per vehicle

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

m – Volume for 95th percentile queue is metered by upstream signal

As shown, based upon the Synchro analysis, the study intersections generally have favorable conditions during both peak periods with the exception of Delmar Boulevard and the Northbound and Southbound I-170 Ramps. The other eight study intersections all have acceptable levels of service. The volume to capacity ratios for each approach at the other intersections indicate that there is surplus capacity within the study area other than at the I-170 ramps. The signalized intersections of McKnight Road at the I-170 Northbound On-Ramp, Delmar Boulevard at Delcrest Drive, and Delmar Boulevard at Old Bonhomme Road all have a LOS of D or better. The unsignalized intersections, Delmar Boulevard at Lepere Street/Kingdel Drive, Delmar Boulevard at Canterbury Road, Delmar Boulevard at McKnight Place, Delmar Boulevard at Ladue Crossing Access Road, and Delmar Boulevard at Berick Drive all have a LOS of D or better.

Delmar Boulevard at the I-170 Northbound Ramps/McKnight Road experiences a failing LOS on the northbound approach during the PM peak hour with calculated queues reaching 17 vehicles. The volume to capacity ratio at this intersection is 1.09 which indicates that the northbound approach could be operating over capacity in its current condition. However, as stated by CBB in their *Traffic Impact Study for Proposed Mixed-Use Development at 8400 Delmar Boulevard* dated July 23, 2020, the failing LOS may be due to the software overestimating the northbound delays; in particular, the northbound right turn movement. Field observations completed by both CBB and LochGroup indicated that more right-turns are getting through then the program calculates. Therefore, it appears that the LOS F calculated for the northbound off ramp from I-170 may be overstated.

The southbound approach of McKnight Road to Delmar Boulevard currently operates at a LOS E during the same time period. The volume to capacity ratio at this approach is 0.91 during the PM peak hour, indicating that the southbound volume is approaching the theoretical capacity.

Additionally, Delmar Boulevard at the I-170 Southbound Ramps also has a LOS E during the PM peak hour for the southbound approach with calculated queues reaching approximately 13 vehicles. The volume to capacity ratio for the southbound approach reaches 0.84. While the volume to capacity ratio is still acceptable, any additional traffic introduced may have a pronounced impact on the approach given it is nearing capacity.

It is important to note that both of these intersections are the ramps which lead from I-170 to Delmar Boulevard and significant queueing could result in back-ups onto I-170 itself. Currently, both I-170 off-ramps have enough distance to accommodate the existing queues without backing up onto I-170, as verified by field observations during the PM peak hour

From an access management perspective, it is undesirable how close the intersection of Ladue Crossing Access Road to Delmar Boulevard is to the intersection with the Northbound I-170 Ramps. However, this intersection has been in place for many years and a time-based restriction is in place which prohibits left-turns from 4:00-6:00 PM Mondays-Fridays. Nevertheless, twelve vehicles were counted attempting to turn left onto westbound Delmar Boulevard in the PM; disregarding the prohibition.

This results in not only traffic operational issues given the lack of adequate space between the intersections, but it also poses a safety issue given the potential for westbound queues to extend past Ladue Crossing Access Drive and the existing eastbound left turn lane on Delmar Boulevard serving the retail center in the northeast quadrant of the intersection. It is recommended that the intersection be monitored during the PM peak period to ensure enforcement of the time based no left-turn restriction. Should the time-based restriction prove difficult to enforce, a physical restriction could be considered in the future to prevent northbound left-turns. It should be noted that this physical restriction should not be the responsibility of any of the developments under consideration in this study since the issues associated with the left turn movement arise with or without the redevelopments along Delcrest Drive. It should also be noted that this is a private road so any change in access would have to be discussed with the owners before implementation.

Proposed Developments

The City's desire for the comprehensive traffic study was due to the multiple development proposals in the vicinity of the I-170 and Delmar interchange and a need to identify the relative responsibility for each of the redevelopment proposals to provide identified infrastructure improvements. The three developments currently under consideration by the City are:

- Delcrest Plaza Development
- Delmar Mixed Use Development
- Crown Center Development

Delcrest Plaza Development

In forecasting the impacts of the development of Delcrest Plaza upon the traffic conditions along Delmar Boulevard, it was necessary to identify the site's trip generation potential, as any impacts to the surrounding road system would be tied to the net increase in trip generation. The proposed site plan for the Delcrest Plaza development is shown in **Figure 4.**

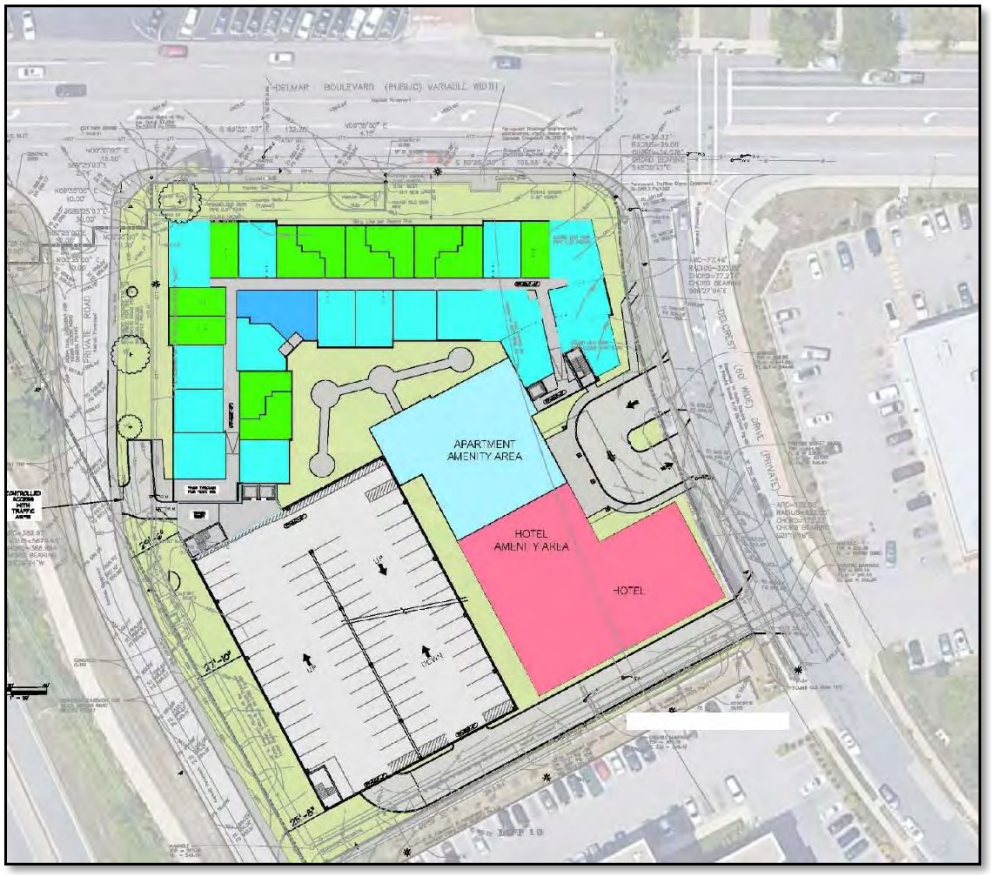

Figure 4. Preliminary Delcrest Plaza Site Plan (Provided by Others)

As previously stated, the Delcrest Plaza development, located at 8400 Delmar, includes a 133-room hotel, a 285-unit apartment building, and 4,000 SF of retail/restaurant space. The site-generated traffic volumes for the Delcrest Plaza development were estimated based on the number of proposed dwelling units for multi-family housing, bedrooms for hotel, and gross floor area for the high-turnover sit-down restaurant (HTSD). The trip generation estimates were based on the Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th Edition. In this case, the following land uses were used:

- Land Use 221: Multi-Family House – Mid-Rise
- Land Use 310: Hotel
- Land Use: 932 HTSD Restaurant

The forecasted trips that would be generated by the proposed redevelopment are summarized in **Table 3**. As shown, the proposed Delcrest Plaza development would generate a total of approximately 210 and 245 trips during the weekday morning and evening peak hours, respectively. It should be noted that these trip generation values agree with those stated in CBB's *Traffic Impact Study for Proposed Mixed-Use Development at 8400 Delmar Boulevard*, dated July 23, 2020.

Table 3. Delcrest Plaza Trip Generation Estimate

Land Use	Unit	Size	Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
Multi-Family Housing Low-Rise (220)	Dwelling Unit	285	30	75	105	75	50	125
Hotel (310)	Rooms	133	40	25	65	40	40	80
HTSD Restaurant (932)	GFA	4,000	20	20	40	25	15	40
	Total		**90**	**120**	**210**	**140**	**105**	**245**

Primary access is provided via one full access driveway on Delcrest Drive, approximately 290 feet south of Delmar Boulevard. In addition, a pick-up/drop-off loop is proposed off Delcrest Drive. The trash pick-up is planned via a new curb cut along Ladue Crossing Access Road. The proposed development plans to remove the two existing full access curb cuts along Delmar Boulevard.

The proposed directional distribution percentages for the Delcrest Plaza site generated new trips are presented in

Table *4*. The majority of new inbound trips are expected to travel from the west on Delmar Boulevard using I-170 to and from the site as shown in **Figure 5.** It should be noted that the directional distribution values below agree with those stated in CBB's *Traffic Impact Study for Proposed Mixed-Use Development at 8400 Delmar Boulevard*, dated July 23, 2020.

Table 4. Directional Distribution Percentages Applied to Delcrest Development

To/From	Percentage
55% from the West on Delmar Boulevard	
North on I-170	25%
South on I-170	15%
South on Ladue Crossing	5%
North on McKnight Road	5%
Far West on Delmar Boulevard	5%
45% from the East on Delmar Boulevard	
East on Delmar Boulevard	30%
South on Old Bonhomme Road	10%
North on Old Bonhomme Road	5%

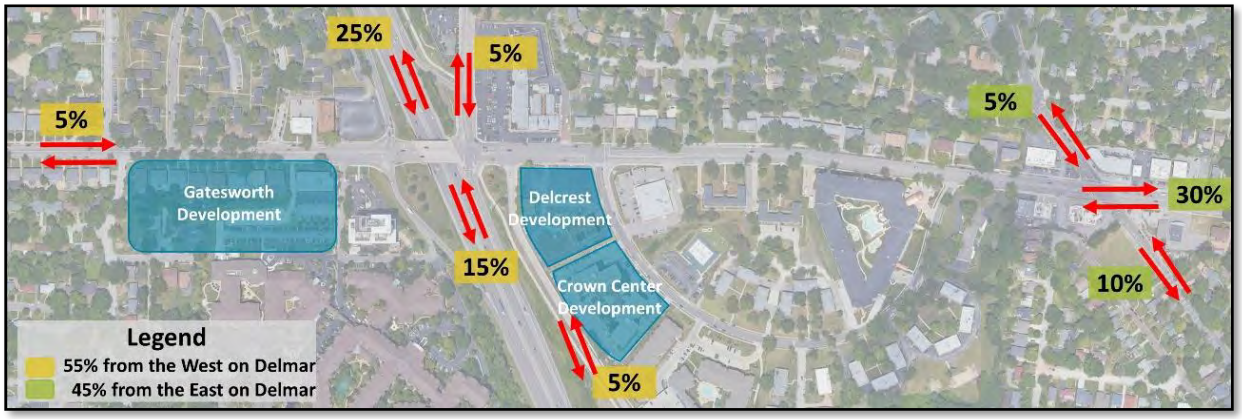

Figure 5. Directional Distribution for Delcrest Plaza Development

The additional traffic attributable to the redevelopment of Delcrest Plaza are shown in **Figure 6**.

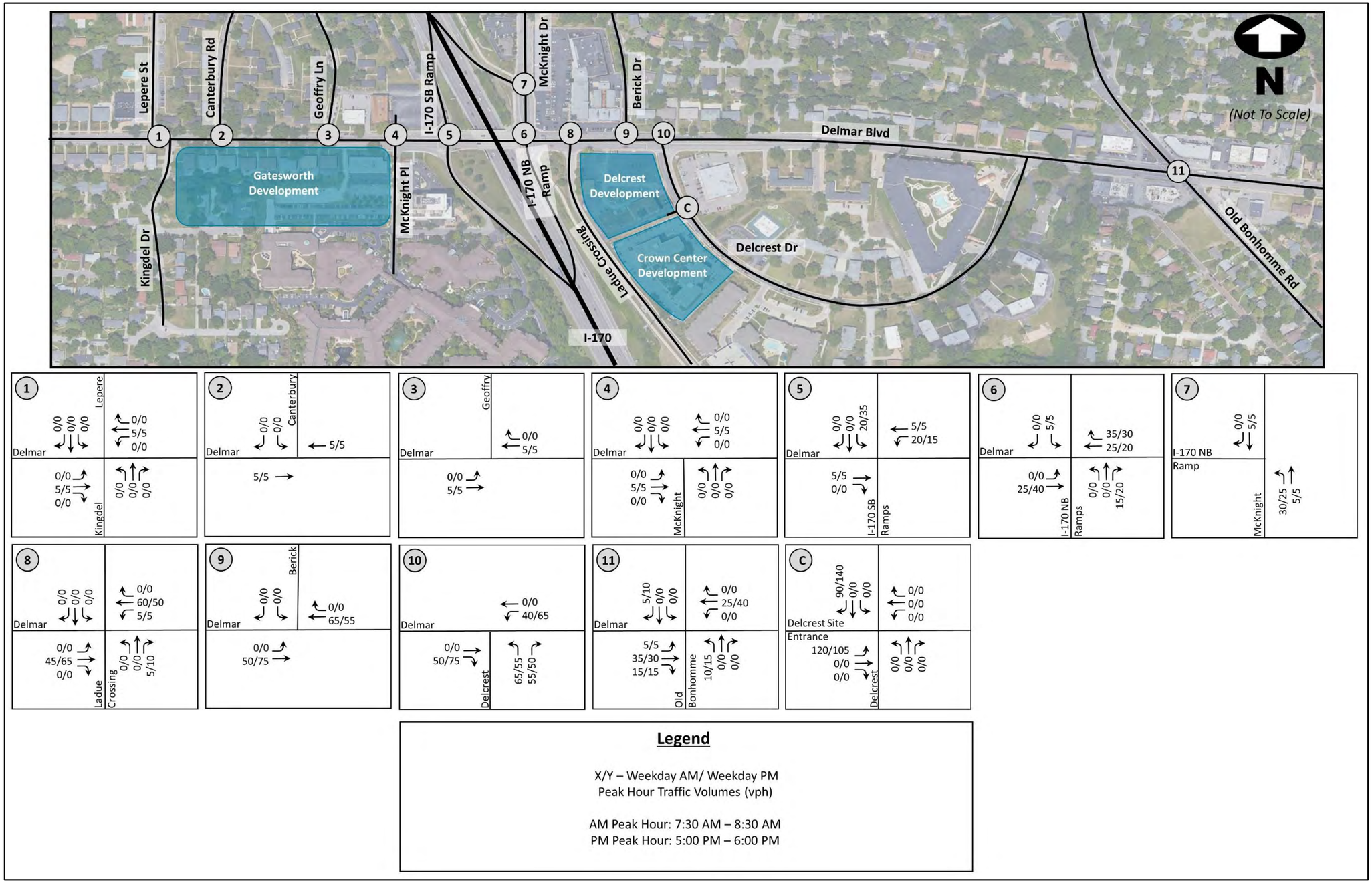

Figure 6. Delcrest Plaza Site Generated Trips

Delmar Mixed Use Development

West of I-170, the proposed Delmar Mixed Use development would be constructed immediately west of the existing Gatesworth community. The development is to include approximately 258 apartment units with integrated structured parking and a separate 2,098 SF coffee shop with drive-through service. Primary access is proposed via two new full-access driveways on Delmar Boulevard. As part of the development plan, McKnight Place would be realigned slightly to remove the curve in the roadway as it approaches Delmar Boulevard. The proposed site plan for the Delmar mixed-use development is shown in **Figure 7.**

The site-generated traffic volumes for the Delmar Mixed Use development were estimated based on the number of proposed dwelling units for multi-family housing and gross floor area for the coffee shop with drive-through service. The trip generation estimates were based on the Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th Edition. In this case, the following land uses were used:

- Land Use 221: Multi-Family House – Mid-Rise
- Land Use 937: Coffee/Donut Shop with Drive-Through Window

The forecasted trips that would be generated by the proposed development are summarized in

Table *5*. Given the nature of a coffee shop with a drive-through window, it is reasonable to assume that some trips would be "pass-by" trips. "Pass-by" trips do not increase traffic along the network roads, rather they increase traffic along the site entrances as more cars choose to enter the site to visit the coffee shop. Additionally, since this coffee shop is located near the Delmar Boulevard and I-170 interchange, it can be reasonably assumed that some trips would be "diverted" as they choose the visit the coffee shop on their way to their destination. These "diverted link" trips would exit the I-170 ramps onto Delmar Boulevard, arrive at the coffee shop, then re-enter I-170 to continue to their original destination.

As shown, the proposed Delmar mixed-use development would generate a total of approximately 185 and 155 new trips during the weekday morning and evening peak hours, respectively. It should be noted that these trip generation values agree with those stated in CBB's *Traffic Impact Study for Proposed Mixed-Use Development at Delmar Boulevard at McKnight Place*, dated July 23, 2020.

Table 5. Delmar Mixed-Use Trip Generation Estimate

Land Use	Unit	Size	Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
Multi-Family Housing Mid-Rise (221)	Dwelling Unit	258	25	65	90	65	45	110
Coffee/Donut Shop with Drive-Through Window (937)	GFA	2,098	100	95	195	45	50	95
Total			**125**	**160**	**285**	**110**	**95**	**205**
Pass-By Trips (Coffee Shop)			20	20	40	10	10	20
Diverted Link Trips (Coffee Shop)			30	30	60	15	15	30
New Trips			**75**	**110**	**185**	**85**	**75**	**155**

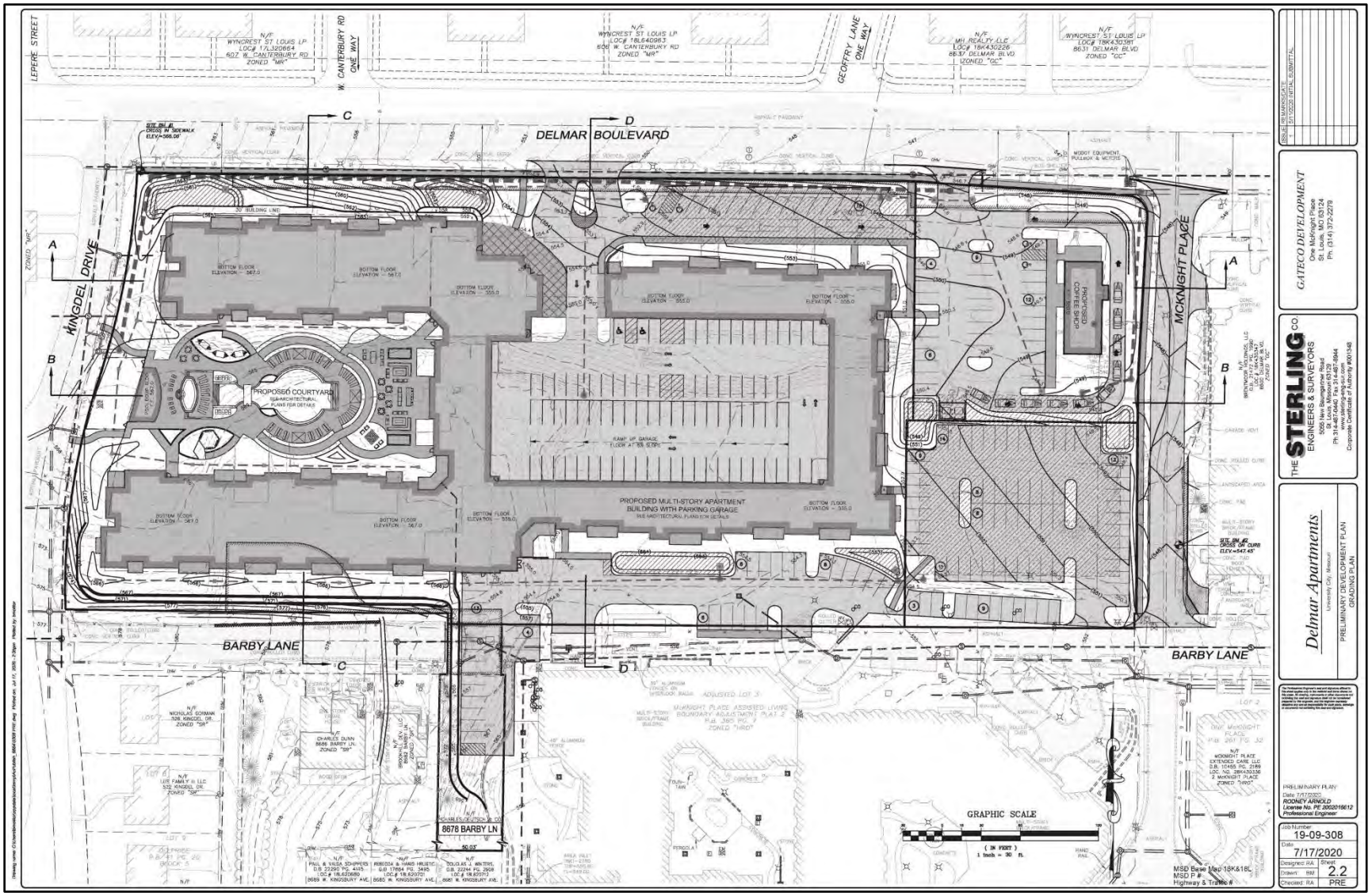

Figure 7. Delmar Mixed Use Site Plan (Provided by Others)

The proposed directional distribution percentages for the Delmar Mixed Use site's new trips are presented in **Table 6.** The majority of new inbound trips are expected to travel from the south on I-170 to and from the site as shown in **Figure 8.** It should be noted that directional distribution values agree with those stated in CBB's *Traffic Impact Study for Proposed Mixed-Use Development at Delmar Boulevard at McKnight Place* dated July 23, 2020.

Table 6. Directional Distribution Percentages Applied to Delmar Mixed Use Development

To/From	Percentage
South on I-170	40%
North on I-170	30%
East on Delmar	20%
West on Delmar	10%

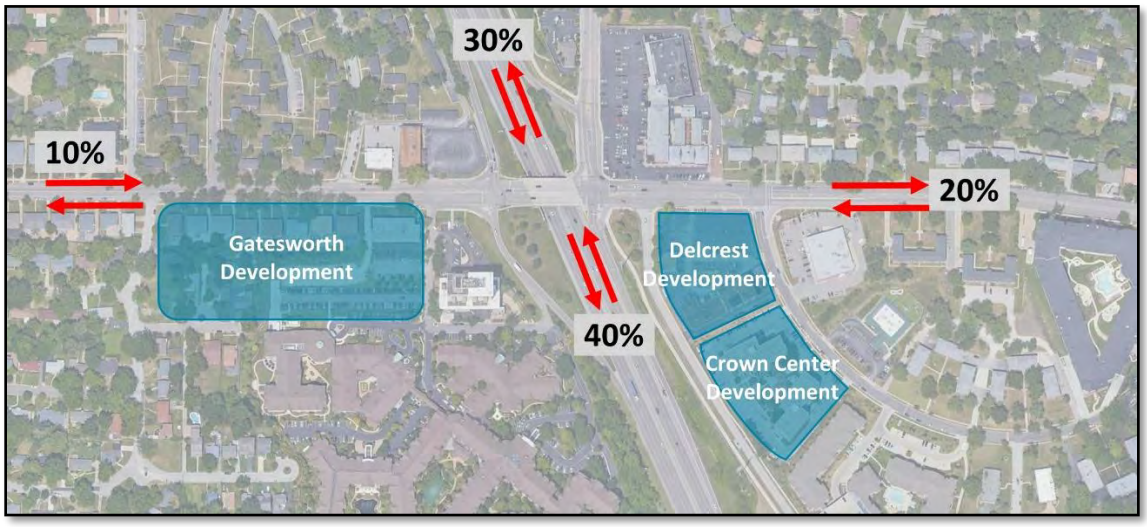

Figure 8. Directional Distribution for Delmar Mixed Use Development

The proposed site generated trips for the Delmar Mixed Use development are shown in **Figure 9.**

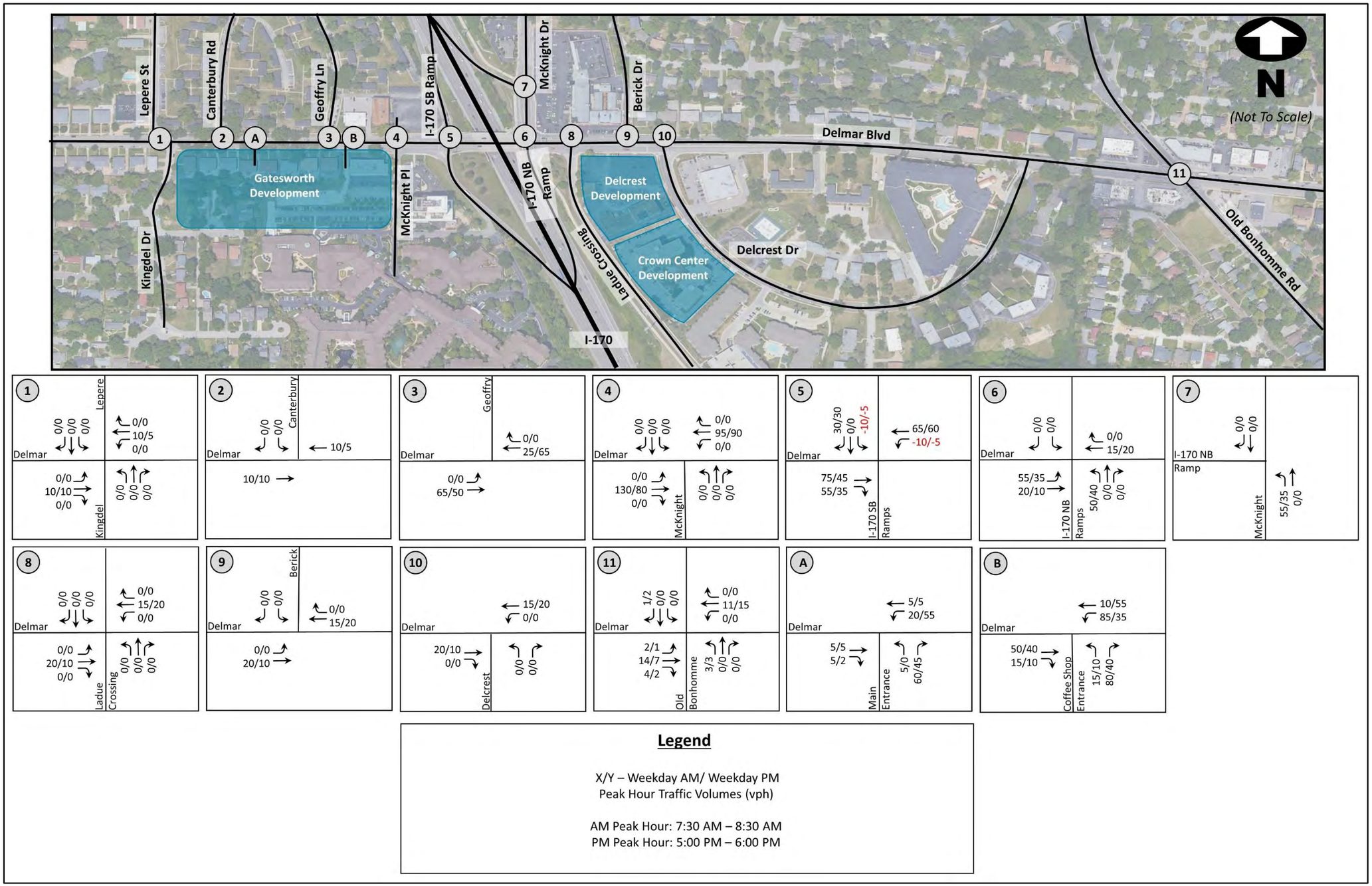

Figure 9. Delmar Mixed Use Site Generated Trips

Crown Center Development

Lastly, the third redevelopment is the Crown Center site, which is located in the southeast quadrant of the interchange, immediately south of the Delcrest Plaza redevelopment. The redevelopment of the Crown Center site, located at 8348-8350 Delcrest Drive, has filed a one-year extension for their previously approved Amended Final Development Plan. This redevelopment includes the construction of a 238-unit multi-family residential development for senior living with associated accessory uses. The proposed site plan for the Crown Center redevelopment is shown in **Figure 10**.

Currently, the Crown Center has an existing 244-unit multi-family residential development for senior living with associated accessory services on site. Therefore, the "redevelopment" would essentially be an update to the existing facilities without changing the use, significantly modifying the number of units provided, or the site's access. Therefore, the redevelopment of Crown Center would not contribute any additional traffic to the surrounding road system. **For this reason, no additional analysis has been completed for the Crown Center development as it was determined that the development is already captured in the existing conditions analysis.**

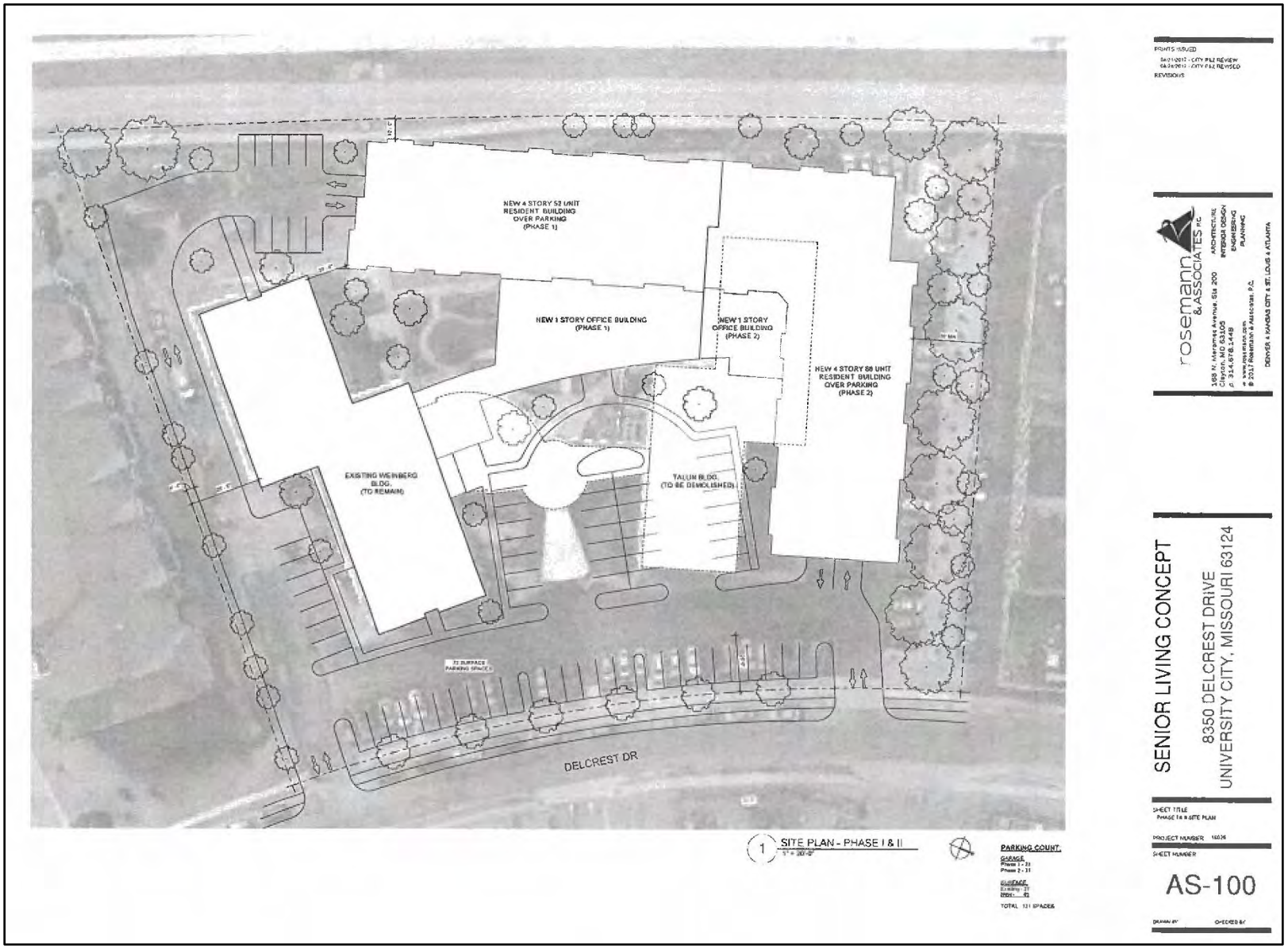

Figure 10. Crown Center Site Plan (Provided by Others)

Traffic Impacts of Delcrest Plaza Redevelopment

The forecasted operating conditions following the redevelopment of Delcrest Plaza located at 8400 Delmar (and none of the other development proposals) were evaluated using the same methodology applied to existing conditions. Synchro 10 was used for capacity analysis of all signalized and unsignalized intersections. The site generated traffic (**Figure 6**) volumes for Delcrest Plaza were aggregated with existing traffic volumes (**Figure 3**) to produce the 2020 forecasted traffic volumes assuming only Delcrest Plaza is redeveloped, as shown in **Figure 11**.

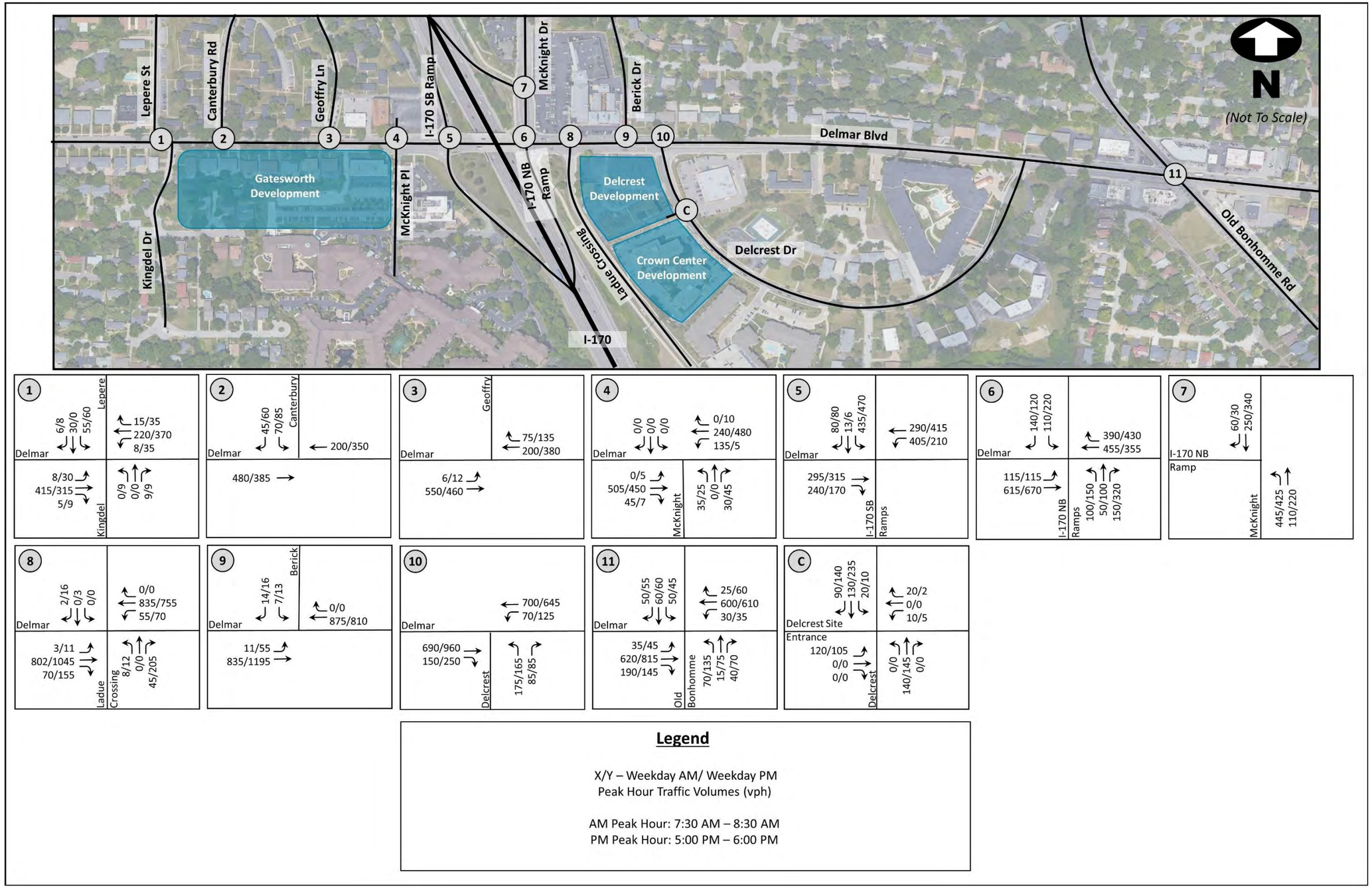

Figure 11. 2020 Forecasted Traffic Volumes – Delcrest Plaza Redevelopment Only

Table 7 shows the 2020 forecasted operating conditions that reflect the additional trips generated by the proposed Delcrest Plaza Development added to the study area road system.

Table 7. 2020 Forecasted Operating Conditions – Delcrest Plaza Redevelopment Only

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Lepere St/Kingdel Dr (unsignalized)		
Eastbound Left	A (7.8) [<25] <0.01>	A (8.3) [<25] <0.03>
Westbound Left	A (8.3) [<25] <0.01>	A (8.1) [<25] <0.03>
Northbound Approach	B (11.1) [<25] <0.02>	C (16.1) [<25] <0.06>
Southbound Approach	C (20.5) [33] <0.30>	D (26.0) [33] <0.31>
Delmar Blvd & Canterbury Rd (unsignalized, Side-Street STOP – One-Way Southbound)		
Southbound Approach	C (15.3) [28] <0.27>	C (18.3) [43] <0.37>
Delmar Blvd & Geoffry Ln (unsignalized, One-Way Northbound)		
Eastbound Left	A (0.2) [<25] <0.01>	A (0.4) [<25] <0.01>
Delmar Blvd & McKnight Pl (unsignalized, Side-Street, STOP)		
Eastbound Left	A (0.0) [<25] <0.00>	A (8.5) [<25] <0.01>
Westbound Left	A (9.4) [<25] <0.16>	A (8.4) [<25] <0.01>
Northbound Approach	D (28.2) [33] <0.32>	C (18.6) [<25] <0.23>
Southbound Approach	A (0.0) [<25] <0.00>	A (0.0) [<25] <0.00>
Delmar Blvd & I-170 Southbound Ramps (signalized)		
Overall Intersection	**C (23.5)**	**C (29.6)**
Eastbound Approach	B (13.5) [79] <0.34>	C (21.4) [92] <0.33>
Westbound Approach	B (11.5) [129] <0.59>	A (6.8) [69] <0.25>
Southbound Approach	D (48.3) [241] <0.78>	E (61.7) [#333] <0.86>
Delmar Blvd & I-170 Northbound Ramps/McKnight Rd (signalized)		
Overall Intersection	**B (18.8)**	**D (43.1)**
Eastbound Approach	A (4.5) [74] <0.40>	B (15.6) [307] <0.43>
Westbound Approach	B (19.2) [294] <0.59>	B (17.7) [210] <0.60>
Northbound Approach	C (30.3) [121] <0.75>	F (88.9) [#431] <1.13>
Southbound Approach	D (42.6) [138] <0.63>	F (88.1) [#271] <0.93>
McKnight Rd & I-170 On-Ramp (signalized)		
Overall Intersection	**A (7.3)**	**A (7.4)**
Northbound Approach	A (7.3) [379] <0.51>	A (6.8) [m304] <0.50>
Southbound Approach	A (7.3) [98] <0.14>	A (8.3) [123] <0.17>
Delmar Blvd & Ladue Crossing Access Rd (unsignalized –NBLT Prohibited in PM)		
Eastbound Left	A (9.9) [<25] <0.00>	A (9.4) [<25] <0.01>
Westbound Left	B (10.5) [<25] <0.08>	B (12.6) [<25] <0.14>
Northbound Approach	C (15.1) [<25] <0.16>	E (35.3) [135] <0.72>
Southbound Approach	B (11.5) [<25] <0.00>	C (16.1) [<25] <0.07>

Table 7 Continued. 2020 Forecasted Operating Conditions – Delcrest Plaza Redevelopment Only

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Berick Dr (unsignalized)		
Eastbound Left	B (10.1) [<25] <0.02>	B (10.1) [<25] <0.08>
Southbound Approach	C (15.0) [<25] <0.06>	C (17.6) [<25] <0.10>
Delmar Blvd & Delcrest Dr (signalized)		
Overall Intersection	**B (12.8)**	**B (14.9)**
Eastbound Approach	B (12.7) [220] <0.46>	B (16.7) [377] <0.65>
Westbound Approach	A (6.3) [126] <0.34>	A (5.8) [107] <0.43>
Northbound Approach	C (31.6) [164] <0.64>	D (35.4) [170] <0.63>
Delmar Blvd & Old Bonhomme Rd (signalized)		
Overall Intersection	**B (11.5)**	**B (17.0)**
Eastbound Approach	A (7.5) [163] <0.33>	B (11.4) [259] <0.46>
Westbound Approach	A (7.4) [133] <0.27>	B (10.5) [173] <0.36>
Northbound Approach	C (31.1) [76] <0.34>	D (45.1) [120] <0.69>
Southbound Approach	C (30.8) [79] <0.43>	C (24.1) [74] <0.28>
Delcrest Plaza Site Access & Delcrest Dr (unsignalized, Side-Street, STOP)		
Eastbound Approach	B (13.8) [<25] <0.24>	C (15.3) [25] <0.25>
Westbound Approach	B (10.1) [<25] <0.04>	B (11.8) [<25] <0.01>
Northbound Left	A (0.0) [<25] <0.00>	A (0.0) [<25] <0.00>
Southbound Left	A (7.6) [<25] <0.02>	A (7.6) [<25] <0.01>

Delay presented in seconds per vehicle

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

m – Volume for 95th percentile queue is metered by upstream signal

As can be seen, the 2020 Delcrest Plaza development forecasted operating conditions are similar to the existing conditions for the study intersections. The newly proposed site driveway on Delcrest Drive operates at a LOS C or better with queue lengths equal to one vehicle.

However, the intersections of Delmar Boulevard and the Northbound and Southbound I-170 Ramps continue to experience failing levels of service, comparable to existing conditions. In fact, the southbound approach of McKnight Road to Delmar Boulevard opposite the Northbound I-170 Ramp degrades from an existing LOS E to a forecasted LOS F during the PM peak hour. The Missouri Department of Transportation (MoDOT) Traffic Impact Study (TIS) guidelines state that future conditions should not increase existing delays by more than 15 seconds or one level of service letter. While the LOS is degraded by one level of service, the delay is increased by only 11 seconds. Additionally, only 5 vehicles were added to this movement. Therefore, it is LochGroup's opinion that improvements to this approach would not be the sole responsibility of Delcrest Plaza as this approach to Delmar Boulevard is nearing failing levels of service during existing conditions.

The southbound approach at Delmar Boulevard & I-170 Southbound Ramp remains at a LOS E despite the addition of 35 vehicles in the PM peak hour attributable to the Delcrest Plaza redevelopment. The delay is increased by approximately 3 seconds when compared to existing conditions and the volume to capacity ratio reaches 0.86

during this scenario as opposed to 0.84 in the existing conditions. Therefore, the impact attributable to the redevelopment of Delcrest Plaza is not appreciable and does not dictate the need for improvements due solely to the impact of Delcrest Plaza.

It should be noted that the northbound approach at the intersection of Delmar Boulevard and Ladue Crossing is anticipated to decrease from a LOS D to a LOS E in the PM peak hour. As previously discussed, it is undesirable how close the Ladue Crossing Access Road's intersection with Delmar Boulevard is to the intersection with the Northbound I-170 Ramps. The Delcrest Plaza development is expected to add only 5 and 10 vehicles to the northbound approach in the AM and PM peak hours, respectively. The westbound left turn movement is expected to have an additional 5 vehicles from the development during both the AM and PM peak hours. While the additional traffic at this intersection as a result of the Delcrest Plaza development is minimal, it is still recommended that this intersection be monitored to ensure compliance with the time based no left-turn restriction during the weekday PM period. Should the time-based restriction prove difficult to enforce, a physical restriction could be considered in the future to prevent northbound left-turns. It should be noted that this physical restriction would not be the responsibility of Delcrest Plaza as the issues associated with the left turn movement arise with or without the development.

The other eight study intersections all have acceptable levels of service. The volume to capacity ratios for each approach at the other intersections indicate that there is surplus capacity within the study area other than at the I-170 ramps. The signalized intersections of McKnight Road at the I-170 Northbound On-Ramp, Delmar Boulevard at Delcrest Drive, and Delmar Boulevard at Old Bonhomme Road all have a LOS of D or better. The unsignalized intersections, Delmar Boulevard at Lepere Street/Kingdel Drive, Delmar Boulevard at Canterbury Road, Delmar Boulevard at McKnight Place, Delmar Boulevard at Ladue Crossing Access Road, and Delmar Boulevard at Berick Drive all have a LOS of D or better. **Therefore, no mitigation as a result of Delcrest Plaza was recommended.**

Delcrest Plaza Site Plan Review

A cursory review of the site's internal circulation was performed to verify safe and efficient mobility within the site itself. The consolidation and elimination of access along Delmar Boulevard is a critical step forward in terms of implementing access managements along St. Louis County roadways. Two existing full-access driveways will be removed along the south side of Delmar Boulevard as part of the 8400 Delmar development. Additionally, two existing curb cuts on the west side of Delcrest Drive will be removed. Primary access is provided via one full access driveway on Delcrest Drive, approximately 290 feet south of Delmar Boulevard (in the general vicinity of the Walgreen's driveway). A pick-up/drop-off loop is proposed off Delcrest Drive. A service drive is proposed via a new curb cut along Ladue Crossing Access Road.

The proposed access drive onto Delcrest Drive has been located as far to the south as was deemed practical. However, its separation relative to the Walgreen's access drive is not identified on the provided site development plan or within CBB's study. It would be useful to know the separation between these two drives to ensure that there would be no turning conflicts and that the opposing drives would function as "one" intersection.

Additionally, dimensions were not provided for the pick-up/drop-off loop proposed along Delcrest Drive. It would be imperative to know the dimensions of the proposed pick-up/drop-off loop to ensure maneuverability; thereby minimizing the potential for spillbacks onto Delcrest Drive. In addition, it is recommended that the loop be designed to provide for a bypass lane to ensure that vehicles can maneuver around one another.

The proposed service access on Ladue Crossing Access Road does not appear to meet sight distance requirements. Per the American Association of State Highway Transportation Officials (AASHTO), a minimum of 280 ft of adequate sight distance is required for the left-turn from the proposed service drive (based upon a design speed of 25 mph). Currently, the fence on the Crown Center property is contributing to the limited sight distance. Therefore, the service drive as proposed is not advisable due to potential safety concerns.

It is recommended that this service drive be relocated along Ladue Crossing Access Road to a location that provides for the required sight distance of 280 ft. If necessary, discussions with the Crown Center regarding a more "see through" fencing material could also be pursued. In addition, an effort should be made to use low lying plantings at this service drive to ensure adequate visibility. It is recommended that the petitioner's engineer provide sight distance calculations/diagrams for the ultimate proposed location prior to issuance of a permit.

It should be noted that the *Delcrest Plaza 353 Redevelopment Plan* provided by the Developer and dated July 22, 2020 states that "access to the site includes a right-in/right-out access on Delmar Boulevard." This access is not consistent with the provided site plan or the CBB Traffic Impact Study. Therefore, it is LochGroup's understanding that the stated right-in/right-out access is no longer part of the development. If in fact, this access is to be included with the development, then it is recommended that the Delmar Boulevard right-in/right-out access be further analyzed and reflected in the associated traffic study.

All proposed intersections along Delcrest Drive and the Ladue Crossing Access Road should conform to the sight distance requirements set forth by the American Association of State Highway and Transportation Officials (ASHTO). Furthermore, as part of the design process, care should be given to ensure that signage and/or landscaping does not pose sight distance limitations at any of the proposed drive locations.

Traffic Impacts of Delmar Mixed Use Development

The forecasted operating conditions following the development of the Delmar Mixed Use (and none of the other development proposals) were evaluated using the same methodology applied to existing conditions. Again, Synchro 10 was used for capacity analysis of all signalized and unsignalized intersections. The site generated traffic (**Figure 9**) volumes for the Delmar Mixed Use development were aggregated with existing traffic volumes (**Figure 3**) to produce the 2020 forecasted traffic volumes assuming only the Delmar Mixed Use is redeveloped, as shown in **Figure 12**.

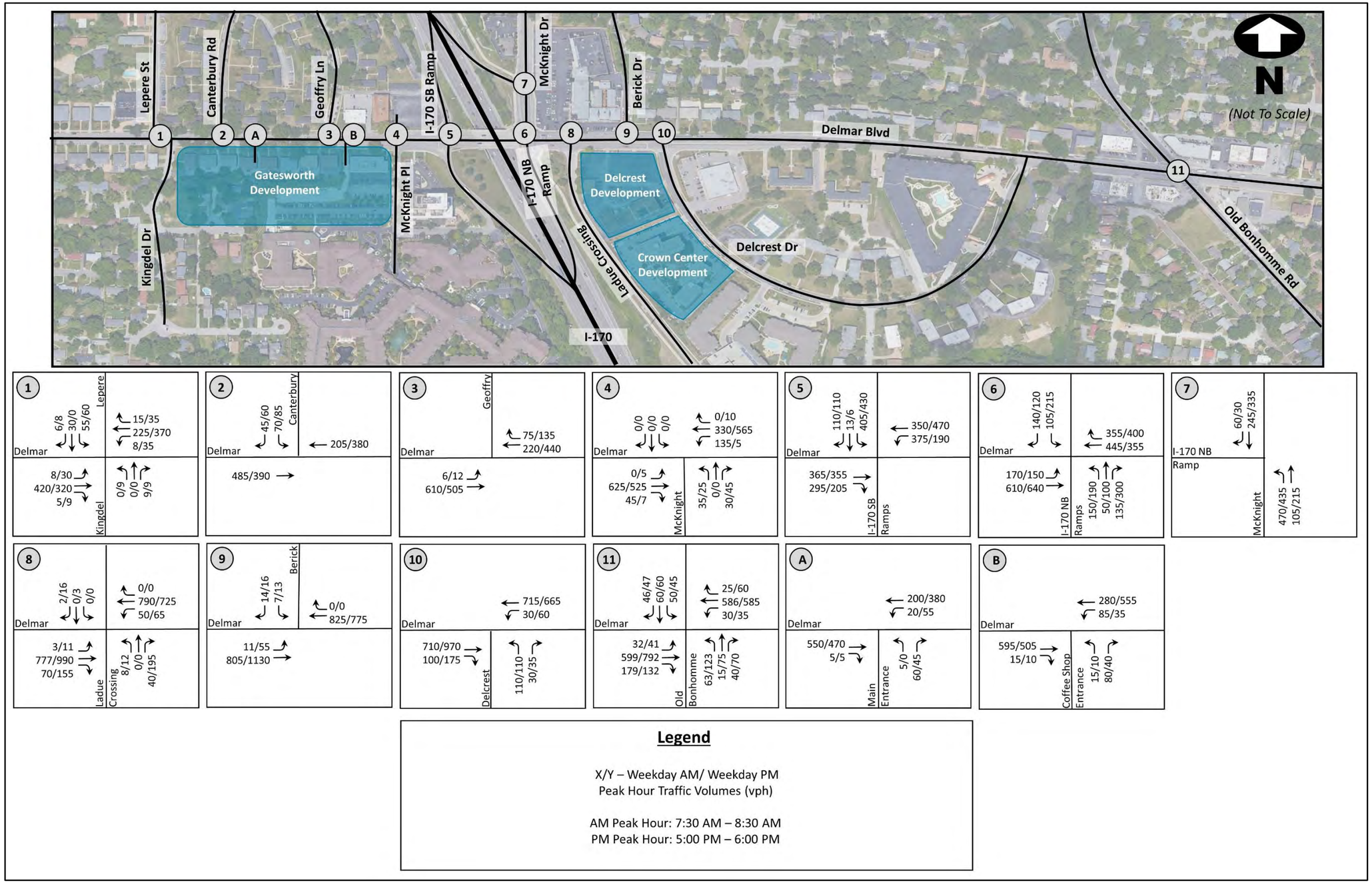

Figure 12. 2020 Forecasted Traffic Volumes – Delmar Mixed Use Redevelopment Only

Table 8 shows the 2020 forecasted operating conditions that reflect the additional trips generated by the proposed Delmar Mixed Use Development added to the study area road system.

Table 8. 2020 Forecasted Operating Conditions – Delmar Mixed Use Redevelopment Only

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Lepere St/Kingdel Dr (unsignalized)		
Eastbound Left	A (7.8) [<25] <0.01>	A (8.3) [<25] <0.03>
Westbound Left	A (8.3) [<25] <0.01>	A (8.1) [<25] <0.03>
Northbound Approach	B (11.2) [<25] <0.02>	C (16.2) [<25] <0.06>
Southbound Approach	C (20.9) [33] <0.31>	D (26.4) [33] <0.31>
Delmar Blvd & Canterbury Rd (unsignalized, Side-Street STOP – One-Way Southbound)		
Southbound Approach	B (13.3) [<25] <0.23>	C (19.4) [45] <0.39>
Delmar Blvd & Geoffry Ln (unsignalized, One-Way Northbound)		
Eastbound Left	A (7.9) [<25] <0.01>	A (8.9) [<25] <0.01>
Delmar Blvd & McKnight Pl (unsignalized, Side-Street, STOP)		
Eastbound Left	A (0.0) [<25] <0.00>	A (8.8) [<25] <0.01>
Westbound Left	B (10.0) [<25] <0.17>	A (8.7) [<25] <0.01>
Northbound Approach	C (21.5) [25] <0.25>	C (16.3) [28] <0.28>
Southbound Approach	A (0.0) [<25] <0.00>	A (0.0) [<25] <0.00>
Delmar Blvd & I-170 Southbound Ramps (signalized)		
Overall Intersection	**C (22.4)**	**C (28.5)**
Eastbound Approach	B (13.8) [97] <0.20>	C (21.2) [103] <0.38>
Westbound Approach	B (10.8) [120] <0.57>	A (8.0) [78] <0.23>
Southbound Approach	D (48.2) [250] <0.78>	E (60.2) [#330] <0.86>
Delmar Blvd & I-170 Northbound Ramps/McKnight Rd (signalized)		
Overall Intersection	**B (19.5)**	**D (40.4)**
Eastbound Approach	A (6.1) [86] <0.55>	B (13.8) [173] <0.52>
Westbound Approach	C (20.4) [295] <0.58>	B (18.6) [212] <0.59>
Northbound Approach	C (30.2) [116] <0.72>	E (78.7) [#408] <1.09>
Southbound Approach	D (42.0) [133] <0.61>	F (84.6) [#268] <0.91>
McKnight Rd & I-170 On-Ramp (signalized)		
Overall Intersection	**A (7.9)**	**A (7.7)**
Northbound Approach	A (8.2) [402] <0.54>	A (7.3) [m320] <0.51>
Southbound Approach	A (7.3) [96] <0.14>	A (8.5) [122] <0.17>
Delmar Blvd & Ladue Crossing Access Rd (unsignalized –NBLT Prohibited in PM)		
Eastbound Left	A (9.6) [<25] <0.00>	A (9.3) [<25] <0.01>
Westbound Left	B (10.3) [<25] <0.07>	B (12.1) [<25] <0.12>
Northbound Approach	B (14.8) [<25] <0.14>	D (29.7) [113] <0.65>
Southbound Approach	B (11.3) [<25] <0.00>	C (15.3) [<25] <0.07>

Table 8 Continued. 2020 Forecasted Operating Conditions – Delmar Mixed Use Redevelopment Only

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Berick Dr (unsignalized)		
Eastbound Left	A (9.9) [<25] <0.02>	A (9.9) [<25] <0.08>
Southbound Approach	B (14.5) [<25] <0.06>	C (16.9) [<25] <0.09>
Delmar Blvd & Delcrest Dr (signalized)		
Overall Intersection	**A (8.7)**	**B (10.4)**
Eastbound Approach	A (8.3) [174] <0.38>	B (11.4) [263] <0.56>
Westbound Approach	A (4.9) [102] <0.33>	A (4.3) [88] <0.29>
Northbound Approach	C (30.6) [99] <0.51>	C (33.8) [113] <0.51>
Delmar Blvd & Old Bonhomme Rd (signalized)		
Overall Intersection	**B (11.3)**	**B (16.6)**
Eastbound Approach	A (7.4) [155] <0.33>	B (11.2) [246] <0.45>
Westbound Approach	A (7.3) [129] <0.27>	B (10.3) [165] <0.35>
Northbound Approach	C (30.0) [70] <0.35>	D (43.3) [120] <0.69>
Southbound Approach	C (31.2) [79] <0.43>	C (24.8) [74] <0.28>
Delmar Blvd & Delmar Apartments Main Entrance (unsignalized, Side-Street, STOP)		
Westbound Left	A (8.8) [<25] <0.02>	A (8.7) [<25] <0.06>
Northbound Approach	B (13.7) [<25] <0.15>	B (12.2) [<25] <0.09>
Delmar Blvd & Coffee Shop Entrance (unsignalized, Side-Street, STOP)		
Westbound Left	A (9.4) [<25] <0.10>	A (8.7) [<25] <0.04>
Northbound Approach	C (16.1) [25] <0.25>	C (13.8) [<25] <0.12>

Delay presented in seconds per vehicle

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

m – Volume for 95th percentile queue is metered by upstream signal

As can be seen, the 2020 Delmar Mixed Use development forecasted operating conditions are similar to the existing conditions for the study intersections. Each of the newly proposed site driveways operates at a LOS C or better with queue lengths of one vehicle or less.

The intersections of Delmar Boulevard and the Northbound and Southbound I-170 Ramps continue to experience failing levels of service. In fact, the southbound approach at the Northbound I-170 Ramp degrades from a LOS E to a LOS F during the PM peak hour. The Missouri Department of Transportation (MoDOT) Traffic Impact Study (TIS) guidelines state that future conditions should not increase existing delays by more than 15 seconds or one level of service letter. While the LOS is degraded by one level of service, the delay is increased by only 8 seconds. No additional vehicles were added to this movement as a result of the Delmar Mixed Use Development. Therefore, it is LochGroup's opinion that improvements to this intersection would not be the sole responsibility of this development as this intersection is nearing failing levels of service during existing conditions.

The southbound approach at Delmar Boulevard and I-170 Southbound Ramps remains at a LOS E. The delay is increased by approximately 2 seconds when compared to existing conditions. The volume to capacity ratio reaches 0.86 during this scenario as opposed to 0.84 in the existing conditions. Based on the minimal increases as a result

of the Delmar Mixed Use Development, this development's traffic does not dictate the need for improvements at this location.

Per CBB's *Traffic Impact Study for Proposed Mixed-Use Development at Delmar Boulevard at McKnight Place* dated July 23, 2020, the recommended two-way left-turn lane between McKnight Place and the newly proposed Delmar Apartments Main Entrance to the west of the site was included in the 2020 build analysis for the Delmar Mixed Use Development. LochGroup agrees that this improvement is appropriate for this section of Delmar Boulevard in order to facilitate the increased turning movements associated with the proposed Mixed-Use Development.

The addition of the two-way left-turn lane significantly improves conditions along the northbound approach at Delmar Boulevard and McKnight Place. Without the two-way left-turn lane, the northbound level of service would reach a LOS E during the AM peak hour, as opposed to the projected LOS C with the two-way left-turn lane in place. The delay is likely caused by the increase in traffic along the eastbound and westbound approaches due to the proposed development and the inability in the existing northbound traffic to find a gap in the traffic to complete their turning movement. However, the two-way left-turn lane provides an opportunity for northbound left-turning vehicles to stage which provides relief to the northbound approach. **For this reason, LochGroup agrees with CBB's recommendation for construction of a two-way left-turn lane between McKnight Place and the newly proposed Delmar Mixed Use Main Entrance. This improvement should be the responsibility of the Delmar Mixed-Use Development.**

Each other study intersection experiences operating conditions that are similar to the existing conditions, and the study intersections generally have favorable conditions during the peak hours with the current lane configuration despite the introduction of additional traffic attributable to the proposed Delmar Mixed Use Development. **Therefore, it can be concluded that the proposed Delmar Mixed-Use development, in and of itself, does not significantly impact traffic operations along the surrounding road network. Other than the provision of a two-way left-turn lane between McKnight Place and the newly proposed Delmar Apartments Main Entrance to the west of the site, no additional mitigation as a result of Delmar Mixed Use Development was recommended.**

Delmar Mixed Use Site Plan Review

A cursory review of the site's internal circulation was performed to verify safe and efficient mobility within the site itself. The consolidation and elimination of access along Delmar Boulevard is a critical step forward in terms of implementing access managements along St. Louis County roadways. Primary access is proposed via two new full-access driveways on Delmar Boulevard. As part of the development plan, McKnight Place would be realigned slightly to remove the curve in the roadway as it approaches Delmar Boulevard.

The proposed east access drive into the coffee shop is offset by approximately 75 feet from Geoffry Lane (to the east). Given that Geoffry lane does not allow exiting traffic (northbound only), no conflicts are anticipated with the proposed east site access drive. Minor conflicts can be anticipated with the drive serving the "Feet for Life" Center, which is located across Delmar Boulevard and approximately 65 feet to the east. However, the "Feet for Life" center does not appear to serve an appreciable amount of traffic and therefore the potential for conflicts between the turning movements into the two drives is nominal.

The proposed west access drive into the apartments is approximately 180 ft east of Canterbury Road and 200 ft west of Geoffry Lane. The addition of a two-way left-turn lane between McKnight Place and the west site access drive minimizes conflicts along the site access drive as vehicles will be able to stage in the two-way left-turn lane. The exact dimensions of the loop at this access are not provided, therefore it was not possible to evaluate the adequacy of the proposed access drive and ensure that adequate room is available for vehicles to maneuver while minimizing pavement width.

The proposed site plan does not provide cross access to the existing Gatesworth Community. Cross access is vital as tenants of the Gatesworth community should be able to access the proposed coffee shop without having to rely upon Delmar Boulevard and thereby add unnecessary turning movements. LochGroup recommends providing cross access between the site and the Gatesworth community in order to improve access and circulation.

The two-way traffic flow proposed for the parking garage appears acceptable. The proposed traffic flow pattern throughout the site appears acceptable as well. It should be noted that the drive-thru for the proposed coffee shop only has room for ten vehicles. Drive thru queues for a coffee shop typically range between 7 to 13 vehicles. While the proposed supply is within that range, it may be prudent to provide additional analysis specific to the proposed coffee shop to ensure that there is enough room for vehicles to queue in the drive-thru lane without spilling into the parking lot. It is important to note, that if the drive-thru queue exceeds 10 vehicles, the vehicles will queue within the parking lot and should not impact Delmar Boulevard.

All proposed intersections along Delmar Boulevard should conform to the sight distance requirements set forth by the American Association of State Highway and Transportation Officials (ASHTO). Furthermore, as part of the design process, care should be given to ensure that signage and/or landscaping does not pose sight distance limitations at any of the proposed drive locations.

2020 Comprehensive Traffic Conditions

This forecasted scenario represents conditions in 2020 with both the Delcrest Plaza Development and Delmar Mixed-Use Development It should be noted that the redevelopment of Crown Center would not contribute any additional traffic to the surrounding road system as there are no proposed changes in use, access, or size. The existing traffic volumes depicted in **Figure 3** were combined with the site generated traffic volumes reflected in **Figure 6** and **Figure 9**, resulting in the 2020 forecasted traffic volumes illustrated in **Figure 13**. These traffic volumes were the basis of the 2020 forecasted comprehensive analysis.

2020 Comprehensive Forecasted Operating Conditions

The same methodology applied to the existing conditions was again applied to the 2020 comprehensive forecasted volumes in an effort to determine the adequacy of the road network to accommodate traffic generated by the proposed developments and identify any mitigation measures that may be necessary. The 2020 comprehensive forecasted operating conditions without additional improvements are summarized in **Table 9**.

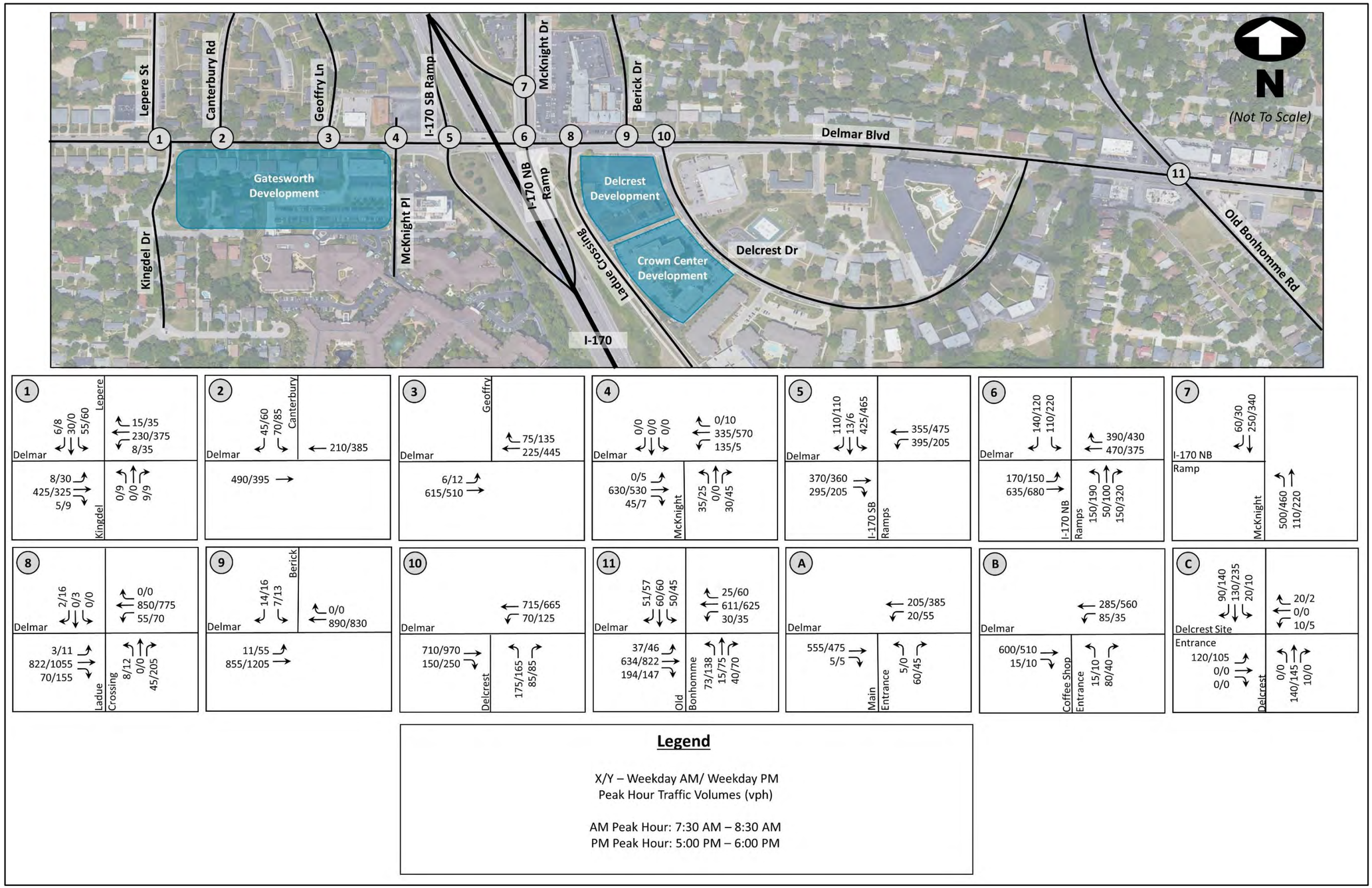

Figure 13. 2020 Comprehensive Traffic Volumes - Inclusive of all Three Developments

Table 9. 2020 Comprehensive Operating Conditions - Inclusive of all Three Developments

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Lepere St/Kingdel Dr (unsignalized)		
Eastbound Left	A (7.8) [<25] <0.01>	A (8.4) [<25] <0.03>
Westbound Left	A (8.3) [<25] <0.01>	A (8.1) [<25] <0.03>
Northbound Approach	B (11.2) [<25] <0.02>	C (16.4) [<25] <0.06>
Southbound Approach	C (21.3) [33] <0.32>	D (26.9) [33] <0.32>
Delmar Blvd & Canterbury Rd (unsignalized, Side-Street STOP – One-Way Southbound)		
Southbound Approach	C (15.7) [28] <0.28>	C (19.7) [48] <0.40>
Delmar Blvd & Geoffry Ln (unsignalized, One-Way Northbound)		
Eastbound Left	A (8.0) [<25] <0.01>	A (8.9) [<25] <0.01>
Delmar Blvd & McKnight Pl (unsignalized, Side-Street, STOP)		
Eastbound Left	A (0.0) [<25] <0.00>	A (8.8) [<25] <0.01>
Westbound Left	B (10.1) [<25] <0.18>	A (8.7) [<25] <0.01>
Northbound Approach	C (21.7) [25] <0.25>	C (16.4) [<25] <0.20>
Southbound Approach	A (0.0) [<25] <0.00>	A (0.0) [<25] <0.00>
Delmar Blvd & I-170 Southbound Ramps (signalized)		
Overall Intersection	**C (23.3)**	**C (30.4)**
Eastbound Approach	B (14.2) [99] <0.39>	C (21.6) [104] <0.38>
Westbound Approach	B (12.8) [151] <0.61>	A (8.1) [76] <0.25>
Southbound Approach	D (47.8) [257] <0.79>	E (64.3) [#363] <0.89>
Delmar Blvd & I-170 Northbound Ramps/McKnight Rd (signalized)		
Overall Intersection	**C (20.3)**	**D (42.8)**
Eastbound Approach	A (6.8) [94] <0.57>	B (14.7) [m308] <0.55>
Westbound Approach	C (21.6) [#352] <0.62>	C (20.0) [236] <0.63>
Northbound Approach	C (30.4) [116] <0.75>	F (84.8) [#431] <1.13>
Southbound Approach	D (42.6) [138] <0.63>	F (89.3) [#277] <0.93>
McKnight Rd & I-170 On-Ramp (signalized)		
Overall Intersection	**A (8.6)**	**A (8.0)**
Northbound Approach	A (9.3) [426] <0.57>	A (7.5) [m342] <0.54>
Southbound Approach	A (7.3) [98] <0.14>	A (8.8) [124] <0.17>
Delmar Blvd & Ladue Crossing Access Rd (unsignalized –NBLT Prohibited in PM)		
Eastbound Left	A (9.9) [<25] <0.00>	A (9.5) [<25] <0.01>
Westbound Left	B (10.6) [<25] <0.09>	B (12.7) [<25] <0.14>
Northbound Approach	C (15.3) [<25] <0.16>	E (36.0) [138] <0.72>
Southbound Approach	B (11.6) [<25] <0.01>	C (16.4) [<25] <0.07>
Delmar Blvd & Berick Dr (unsignalized)		
Eastbound Left	B (10.2) [<25] <0.02>	B (10.2) [<25] <0.08>
Southbound Approach	B (15.2) [<25] <0.06>	C (17.8) [<25] <0.10>

Table 9 Continued. 2020 Comprehensive Operating Conditions - Inclusive of all Three Developments

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Delcrest Dr (signalized)		
Overall Intersection	**B (12.8)**	**B (14.9)**
Eastbound Approach	B (12.9) [226] <0.47>	B (16.8) [383] <0.66>
Westbound Approach	A (6.3) [129] <0.34>	A (5.9) [111] <0.43>
Northbound Approach	C (31.7) [166] <0.64>	D (35.4) [170] <0.63>
Delmar Blvd & Old Bonhomme Rd (signalized)		
Overall Intersection	**B (11.5)**	**B (17.1)**
Eastbound Approach	A (7.5) [167] <0.35>	B (11.5) [263] <0.47>
Westbound Approach	A (7.4) [135] <0.28>	B (10.6) [177] <0.37>
Northbound Approach	C (31.6) [79] <0.41>	D (45.7) [120] <0.69>
Southbound Approach	C (30.8) [79] <0.43>	C (24.0) [74] <0.28>
Delcrest Plaza Site Access & Delcrest Dr (unsignalized, Side-Street, STOP)		
Eastbound Approach	B (13.8) [<25] <0.24>	C (15.3) [25] <0.25>
Westbound Approach	B (10.1) [<25] <0.04>	B (11.8) [<25] <0.01>
Northbound Left	A (0.0) [<25] <0.00>	A (0.0) [<25] <0.00>
Southbound Left	A (7.6) [<25] <0.02>	A (7.6) [<25] <0.01>
Delmar Blvd & Delmar Apartments Main Entrance (unsignalized, Side-Street, STOP)		
Westbound Left	A (8.8) [<25] <0.02>	A (8.7) [<25] <0.06>
Northbound Approach	B (13.8) [<25] <0.15>	B (12.2) [<25] <0.09>
Delmar Blvd & Coffee Shop Entrance (unsignalized, Side-Street, STOP)		
Westbound Left	A (9.4) [<25] <0.10>	A (8.8) [<25] <0.04>
Northbound Approach	C (16.2) [25] <0.25>	C (13.9) [<25] <0.12>

Delay presented in seconds per vehicle

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

m – Volume for 95th percentile queue is metered by upstream signal

As shown, many of the study intersections would continue to operate with satisfactory levels of service and manageable delays. Similar to the 2020 Forecasted Operating Conditions for the Delmar Mixed-Use Development, the recommended two-way left-turn lane between McKnight Place and the newly proposed Main Entrance to the west of the Mixed-Use site was included in the 2020 comprehensive analysis. All newly proposed site access driveways for the Delcrest Plaza Development and Delmar Mixed Use Development are expected to operate favorably with a LOS C or better for both peak hours.

Overall, neither the Delcrest Plaza development nor the Delmar Mixed Use development appear to significantly impact traffic operations throughout the study area. Levels of service are mostly maintained, with queue lengths at unsignalized intersections limited to approximately two vehicles. However, the unsignalized intersection of Delmar Boulevard and Ladue Crossing Access Road does experience a queue length equal to approximately 5 vehicles along the northbound approach. As previously discussed, the degradation in traffic operations at Ladue Crossing Access Road does not appear to be the responsibility

of the Delcrest Development as only 5 and 10 vehicles are added to that approach during the AM and PM peak hours, respectively.

Again, the northbound and southbound I-170 Ramps operate unfavorably. However, conditions under the "comprehensive" analysis are not significantly worse than those under the existing conditions. For example, the southbound off ramp from I-170 prior to considering any development is operating at a LOS E with approximately 58.5 seconds of delay in the PM peak hour. Peak queues measure approximately 305 feet and the volume to capacity ratio is 0.84. When the traffic from the various redevelopment proposals is introduced, this approach continues to operate at LOS E in the PM peak hour with 64.3 seconds of delay on average, an increase of less than 6 seconds. The peak queue length for this time period on the southbound approach would be 330 feet; an increase of one car length. And the volume to capacity ratio would only increase by 0.05.

Similarly, the northbound and southbound approach at Delmar Boulevard and the I-170 North Ramp would be expected to operate at a LOS F in the PM peak hours (again, comparable to existing conditions). The volume to capacity ratio reaches 1.13 and 0.93 for the northbound and southbound approaches, respectively; thereby indicating that this intersection is approaching capacity. However, as previously stated, the failing LOS for the northbound off ramp may be due, in part, to the software overestimating the northbound delays as field observations indicated that more right-turns are getting through then the program calculates. The southbound approach does degrade from an E to a LOS F but the overall increase in vehicular delay is approximately 12 seconds and the increase in the peak queue is about 1.5 car lengths. However, any modifications to the southbound approach are challenging given the extremely close proximity of the signalized intersection to the north that serves the northbound I-170 on ramp and the Centennial Greenway crossing.

Therefore, it does not appear that there is a need for any of the development proposals to mitigate traffic conditions beyond those improvements individually prescribed to each development. However, it is also evident that the interchange of I-170 with Delmar Boulevard/McKnight Road is demonstrating signs of approaching capacity during the weekday PM peak hour even before considering these development proposals. Given the atypical configuration with the northbound on ramp served via McKnight Road, modifications to this interchange would require completion of a preliminary concept study that evaluated conditions on the interstate itself as well. However, there are some methods of mitigation that can be considered at both the Northbound and Southbound I-170 Ramps at Delmar Boulevard to help alleviate traffic constraints in the near term, as follows:

1. Encourage multi-modal use to improve accommodations for non-vehicle modes and help offset impact of developments. University City is prime for multi-modal use with easy access to transit and Centennial Greenway.

2. Enforce the existing northbound left turn restriction on the Ladue Crossing Access Drive's approach to Delmar Boulevard during the weekday PM peak period (4 to 6 PM, Monday thru Friday). The issuance of tickets to offenders should curb the violation of this restriction and

therefore improve operations and safety. Should the use of enforcement prove ineffective, then it is suggested that St. Louis County Department of Transportation enter into discussions with the owner of this private road to consider the installation of a median that would limit left turns.

3. Consider a reallocation of the traffic signals' green time to provide additional time to the off ramps. A progression analysis of the signalized intersections along Delmar Boulevard may prove beneficial.

4. Consider the addition of a third lane to the southbound approach to Delmar Boulevard of the I-170 Southbound off ramp. The proposed lane configuration would be two dedicated left-turn lanes and one shared through/right-turn lane. This improvement would decrease the queue at the southbound approach by approximately 100 ft (4 vehicle lengths) and the volume to capacity ratio is decreased by approximately 14%.

5. Widen the northbound approach at Delmar Boulevard and the I-170 Northbound Ramps to provide a dedicated left-turn lane, a dedicated through lane, and a channelized right-turn lane. This improvement decreases the queue at the southbound approach by approximately 160 ft (6 vehicle lengths) and the volume to capacity ratio is decreased by approximately 19%.

6. Evaluate the feasibility of providing a third lane to the southbound approach to Delmar Boulevard from McKnight Road opposite the I-170 Northbound off ramp. The proposed lane configuration would be two dedicated left-turn lanes and one right-turn lane. Additionally, split phasing would be required with the lane configuration. This improvement, if proved to be physically possible, would decrease the queue at the southbound approach by approximately 150 ft (6 vehicle lengths) and the volume to capacity ratio is decreased by approximately 32%. It should be noted that the close proximity to the signalized intersection to the north, coupled with the right-of-way limitations constrains the width in which to accomplish this improvement. For those reasons, this proposed modification may not be feasible.

7. **Given that both the northbound and southbound I-170 Ramps experience failing levels of service with over saturated volume to capacity ratios in the exiting conditions, it stands to reason that this interchange may be a candidate for a new interchange configuration in the long term. LochGroup recommends that further study be completed that contemplates various interchange configurations that could serve Delmar Boulevard and McKnight Road in order to truly mediate and provide a permanent improvement to the constrained operating conditions at this interchange.**

While these mitigation recommendations may not be necessary at this time, nor attributable to the developments under consideration in this study, as the area continues to develop and additional traffic is introduced, it will be necessary to provide additional relief to the road network.

2040 No Build Conditions

As agreed upon with the City of University City, the annual growth rate to be used in this analysis is 0.50%. **Figure 14** depicts the no-build traffic volumes for 2040, which represent the annual growth rates as applied to the existing traffic volumes illustrated in **Figure 3**.

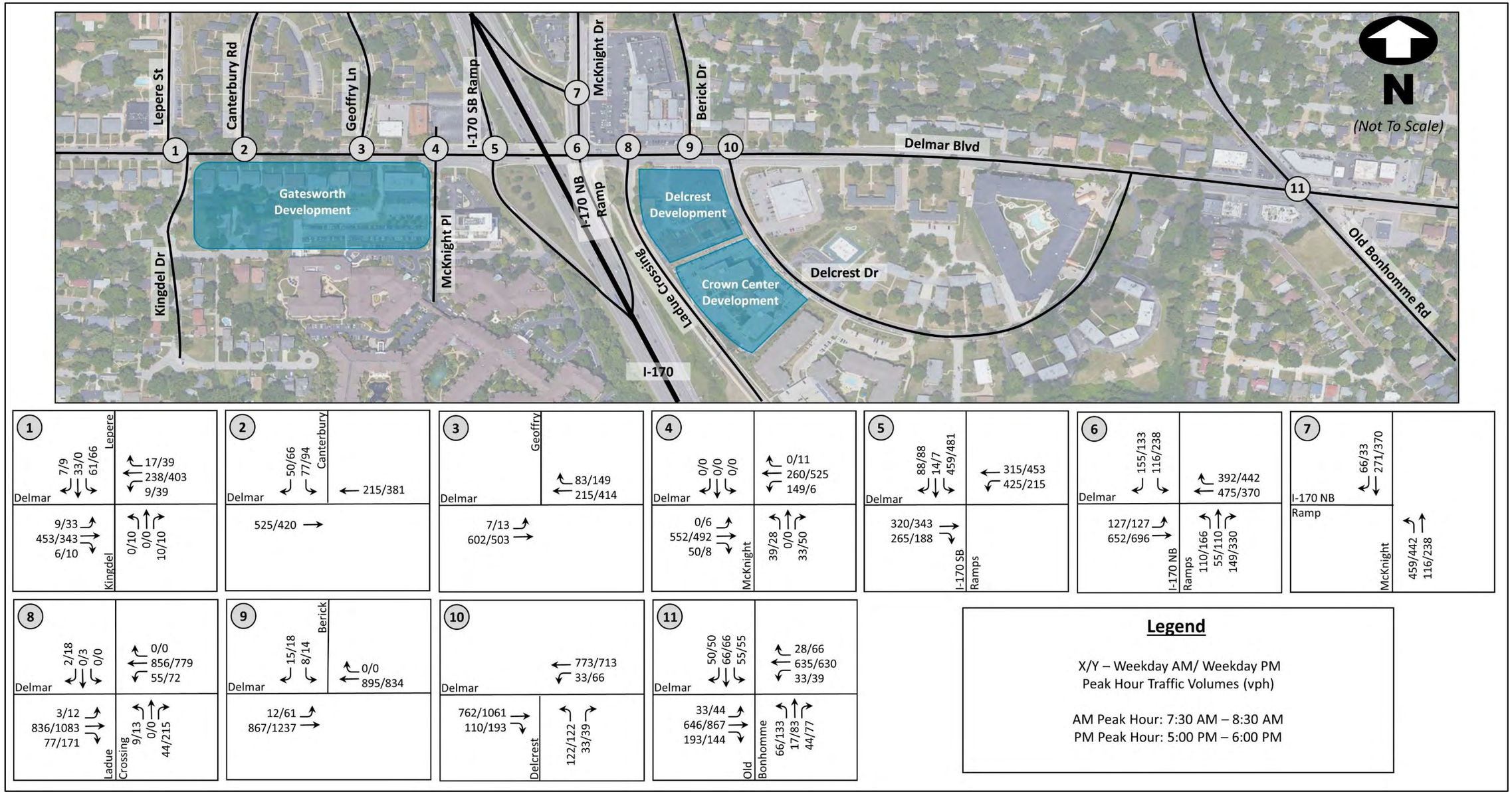

Figure 14. 2040 No-Build Traffic Volumes

2040 No Build Operating Conditions

The same methodology applied to the existing conditions was again applied to the 2040 baseline volumes in an effort to determine the adequacy of the road network to accommodate traffic generated during the 2040 No-Build condition. The 2040 No-Build operating conditions at the intersections included in the study area are summarized in **Error! Not a valid bookmark self-reference.**.

Table 10. 2040 Horizon Year No Build Traffic Operating Conditions

Intersection & Movements	LOS (Delay, sec) [Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Lepere St/Kingdel Dr (unsignalized)		
Eastbound Left	A (7.8) [<25] <0.01>	A (8.5) [<25] <0.03>
Westbound Left	A (8.4) [<25] <0.01>	A (8.2) [<25] <0.04>
Northbound Approach	B (11.5) [<25] <0.02>	C (17.9) [<25] <0.07>
Southbound Approach	C (23.9) [43] <0.37>	D (32.6) [45] <0.39>
Delmar Blvd & Canterbury Rd (unsignalized, Side-Street STOP – One-Way Southbound)		
Southbound Approach	C (16.8) [35] <0.32>	C (21.4) [58] <0.45>
Delmar Blvd & Geoffry Ln (unsignalized, One-Way Northbound)		
Eastbound Left	A (0.2) [<25] <0.01>	A (0.4) [<25] <0.01>
Delmar Blvd & McKnight Pl (unsignalized, Side-Street, STOP)		
Eastbound Left	A (0.0) [<25] <0.00>	A (8.7) [<25] <0.01>
Westbound Left	A (9.8) [<25] <0.18>	A (8.6) [<25] <0.01>
Northbound Approach	E (36.8) [48] <0.42>	C (21.9) [30] <0.29>
Southbound Approach	A (0.0) [<25] <0.00>	A (0.0) [<25] <0.00>
Delmar Blvd & I-170 Southbound Ramps (signalized)		
Overall Intersection	**C (24.5)**	**C (30.2)**
Eastbound Approach	B (14.1) [87] <0.37>	C (21.6) [100] <0.36>
Westbound Approach	B (14.2) [157] <0.64>	A (7.5) [75] <0.26>
Southbound Approach	D (47.9) [261] <0.79>	E (63.9) [#354] <0.88>
Delmar Blvd & I-170 Northbound Ramps/McKnight Rd (signalized)		
Overall Intersection	**B (19.9)**	**D (49.2)**
Eastbound Approach	A (5.1) [74] <0.46>	B (15.7) [318] <0.49>
Westbound Approach	C (20.7) [315] <0.62>	B (19.0) [228] <0.63>
Northbound Approach	C (32.9) [134] <0.77>	F (108.8) [#471] <1.20>
Southbound Approach	D (42.3) [144] <0.65>	F (93.3) [#307] <0.99>
McKnight Rd & I-170 On-Ramp (signalized)		
Overall Intersection	**A (7.7)**	**A (7.6)**
Northbound Approach	A (7.9) [389] <0.54>	A (6.9) [m312] <0.53>
Southbound Approach	A (7.4) [107] <0.15>	A (8.8) [135] <0.19>

Table 11 Continued. 2040 Horizon Year No Build Traffic Operating Conditions

Intersection & Movements	LOS (Delay, sec) [Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Ladue Crossing Access Rd (unsignalized)		
Eastbound Left	A (9.9) [<25] <0.00>	A (9.5) [<25] <0.02>
Westbound Left	B (10.7) [<25] <0.09>	B (13.1) [<25] <0.15>
Northbound Approach	C (15.9) [<25] <0.17>	E (44.0) [168] <0.79>
Southbound Approach	B (11.6) [<25] <0.01>	C (16.5) [<25] <0.08>
Delmar Blvd & Berick Dr (unsignalized)		
Eastbound Left	B (10.2) [<25] <0.02>	B (10.3) [<25] <0.09>
Southbound Approach	C (15.5) [<25] <0.07>	C (18.2) [<25] <0.11>
Delmar Blvd & Delcrest Dr (signalized)		
Overall Intersection	**A (9.8)**	**B (11.4)**
Eastbound Approach	A (9.9) [196] <0.43>	B (12.7) [316] <0.60>
Westbound Approach	A (5.2) [116] <0.36>	A (4.6) [101] <0.30>
Northbound Approach	C (32.1) [116] <0.54>	D (35.7) [124] <0.55>
Delmar Blvd & Old Bonhomme Rd (signalized)		
Overall Intersection	**B (11.7)**	**B (17.6)**
Eastbound Approach	A (7.8) [174] <0.36>	B (12.5) [289] <0.50>
Westbound Approach	A (7.7) [145] <0.30>	B (11.3) [187] <0.38>
Northbound Approach	C (29.6) [72] <0.36>	D (43.8) [132] <0.71>
Southbound Approach	C (31.9) [85] <0.46>	C (24.8) [78] <0.28>

Delay presented in seconds per vehicle

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

m – Volume for 95th percentile queue is metered by upstream signal

As can be seen, the unsignalized drives generally operate with acceptable levels of service with manageable delay at all times of day. The exceptions to this statement are the northbound approach at Delmar Boulevard and McKnight Place in the AM peak hour and the northbound approach to Delmar Boulevard of Ladue Crossing Access Road in the PM peak hour. The northbound approach at Delmar Boulevard and McKnight Place is anticipated to operate at a LOS E in the AM peak hour and through traffic on Delmar Boulevard grows over the next 20 years. However, the delay would still be manageable (36.8 seconds per vehicle) and the approach would operate at only 42% of its capacity. At the intersection of Delmar Boulevard with the Ladue Crossing Access Road, a LOS E is expected in the PM peak hour by the year 2040. Again, this delay is a result of growth in through traffic on Delmar Boulevard over the next 20 years.

As to be expected, the existing operating constraints at the I-170 ramps are exasperated by the 2040 if further improvements are not pursued. The northbound and southbound approaches of the I-170 off ramps approaching Delmar Boulevard would experience a failing LOS in the PM peak hour. The northbound approach has an increase in delay of 26 seconds and the southbound approach has an increase in delay of 16 seconds in the PM peak hour as compared to 2020 existing conditions. **Therefore,**

it can be concluded that mitigation is needed at this interchange just to accommodate growth in background traffic.

2040 Comprehensive Forecasted Conditions

The 2040 comprehensive forecasted operating conditions at the study intersections and proposed access driveways were analyzed based upon the 2040 forecasted traffic volumes illustrated in **Figure 15.** These volumes represent the aggregation of the 2040 baseline traffic volumes with the site generated traffic from the proposed Delcrest Plaza and Delmar Mixed Use redevelopments.

2040 Comprehensive Forecasted Operating Conditions

The same methodology applied to the previous scenarios was again applied to the 2040 comprehensive forecasted volumes in an effort to determine the adequacy of the improved road network to accommodate traffic generated by the proposed developments and identify any mitigation measures that may be necessary. The 2040 forecasted operating conditions are summarized in **Table 11**.

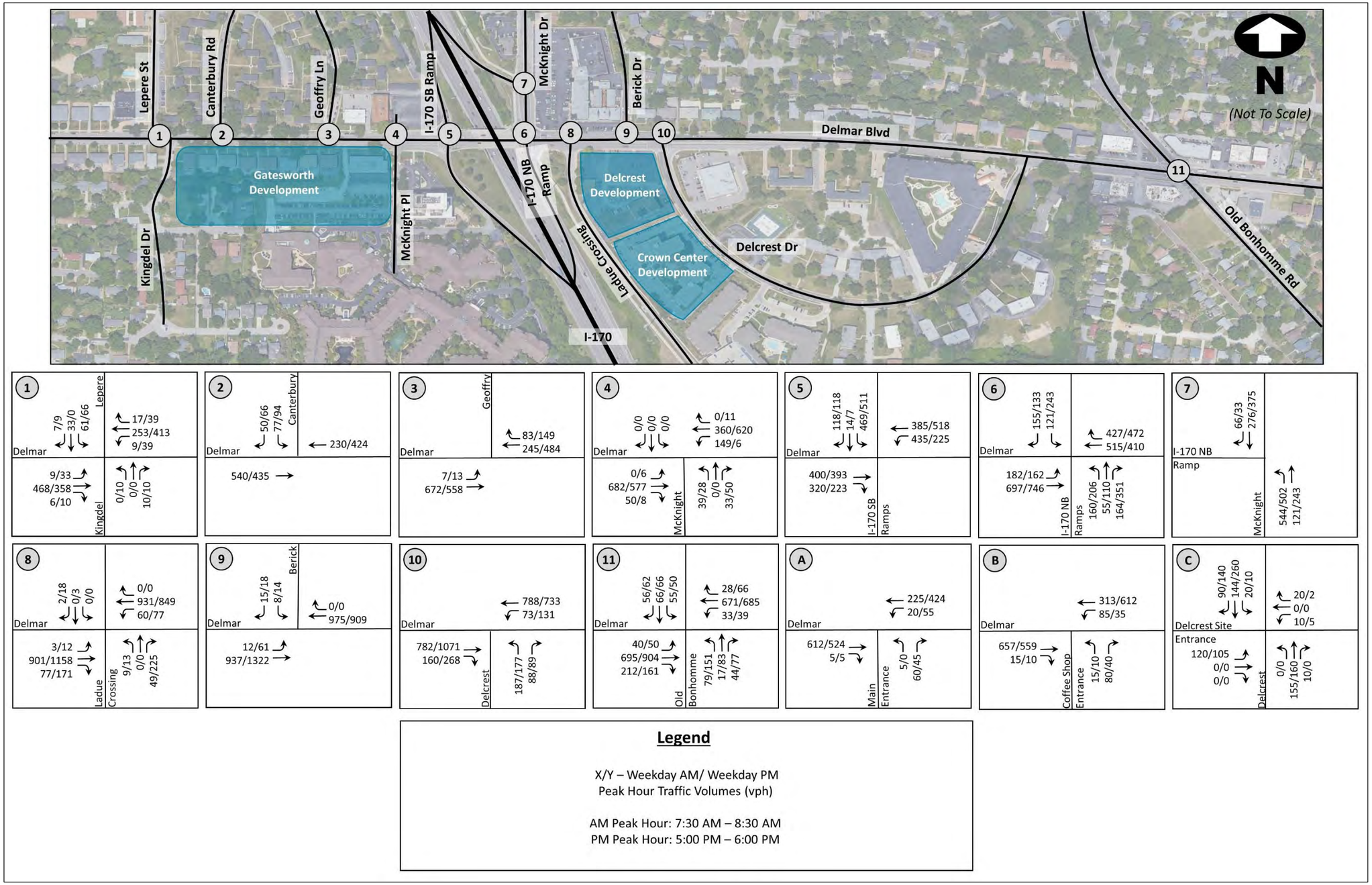

Figure 15. 2040 Comprehensive Traffic Volumes (Inclusive of all Three Developments)

Table 11. 2040 Build Comprehensive Operating Conditions - Inclusive of all Three Developments

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Lepere St/Kingdel Dr (unsignalized)		
Eastbound Left	A (7.9) [<25] <0.01>	A (8.5) [<25] <0.04>
Westbound Left	A (8.5) [<25] <0.01>	A (8.3) [<25] <0.04>
Northbound Approach	B (11.6) [<25] <0.02>	C (18.4) [<25] <0.08>
Southbound Approach	D (25.5) [45] <0.39>	D (34.3) [45] <0.41>
Delmar Blvd & Canterbury Rd (unsignalized, Side-Street STOP – One-Way Southbound)		
Southbound Approach	C (17.6) [35] <0.33>	C (23.9) [65] <0.49>
Delmar Blvd & Geoffry Ln (unsignalized, One-Way Northbound)		
Eastbound Left	A (8.0) [<25] <0.01>	A (9.2) [<25] <0.01>
Delmar Blvd & McKnight Pl (unsignalized, Side-Street, STOP)		
Eastbound Left	A (0.0) [<25] <0.00>	A (9.0) [<25] <0.01>
Westbound Left	B (10.6) [<25] <0.20>	A (8.9) [<25] <0.01>
Northbound Approach	D (25.1) [33] <0.31>	C (18.1) [<25] <0.24>
Southbound Approach	A (0.0) [<25] <0.00>	A (0.0) [<25] <0.00>
Delmar Blvd & I-170 Southbound Ramps (signalized)		
Overall Intersection	**C (28.2)**	**C (33.3)**
Eastbound Approach	B (15.0) [108] <0.44>	C (22.3) [113] <0.42>
Westbound Approach	C (24.4) [236] <0.61>	A (8.8) [83] <0.28>
Southbound Approach	D (48.1) [281] <0.81>	E (71.8) [#414] <0.93>
Delmar Blvd & I-170 Northbound Ramps/McKnight Rd (signalized)		
Overall Intersection	**C (22.8)**	**D (53.2)**
Eastbound Approach	A (9.0) [114] <0.68>	B (16.0) [m323] <0.64>
Westbound Approach	C (24.8) [#420] <0.70>	C (23.0) [281] <0.70>
Northbound Approach	C (33.4) [140] <0.80>	F (122.9) [#507] <1.27>
Southbound Approach	D (42.9) [149] <0.66>	F (93.2) [#318] <1.01>
McKnight Rd & I-170 On-Ramp (signalized)		
Overall Intersection	**B (10.4)**	**A (8.7)**
Northbound Approach	B (12.0) [458] <0.64>	A (8.2) [m369] <0.59>
Southbound Approach	A (7.5) [108] <0.16>	A (9.6) [136] <0.20>
Delmar Blvd & Ladue Crossing Access Rd (unsignalized –NBLT Prohibited in PM)		
Eastbound Left	B (10.3) [<25] <0.01>	A (9.8) [<25] <0.02>
Westbound Left	B (11.1) [<25] <0.10>	B (13.9) [<25] <0.17>
Northbound Approach	C (16.9) [<25] <0.19>	F (59.6) [210] <0.88>
Southbound Approach	B (12.1) [<25] <0.01>	C (18.0) [<25] <0.09>
Delmar Blvd & Berick Dr (unsignalized)		
Eastbound Left	B (10.6) [<25] <0.02>	B (10.7) [<25] <0.10>
Southbound Approach	C (16.5) [<25] <0.07>	C (19.5) [<25] <0.12>

Table 12 Continued. 2040 Build Comprehensive Operating Conditions – Inclusive of all Three Developments

Intersection & Movements	LOS (Delay, sec) [Max Queue Length, feet] <v/c ratio>	
	AM Peak Hour	PM Peak Hour
Delmar Blvd & Delcrest Dr (signalized)		
Overall Intersection	**B (13.6)**	**B (16.8)**
Eastbound Approach	B (13.8) [263] <0.52>	B (19.5) [464] <0.72>
Westbound Approach	A (6.9) [151] <0.38>	A (6.9) [130] <0.50>
Northbound Approach	C (33.3) [181] <0.66>	D (37.0) [183] <0.66>
Delmar Blvd & Old Bonhomme Rd (signalized)		
Overall Intersection	**B (12.0)**	**B (18.2)**
Eastbound Approach	A (8.1) [193] <0.39>	B (12.9) [312] <0.52>
Westbound Approach	A (7.8) [154] <0.31>	B (11.7) [206] <0.41>
Northbound Approach	C (31.6) [83] <0.43>	D (46.7) [132] <0.73>
Southbound Approach	C (31.4) [85] <0.46>	C (23.7) [78] <0.28>
Delcrest Plaza Site Access & Delcrest Dr (unsignalized, Side-Street, STOP)		
Eastbound Approach	B (14.5) [25] <0.26>	C (16.3) [25] <0.26>
Westbound Approach	B (10.3) [<25] <0.05>	B (12.2) [<25] <0.02>
Northbound Left	A (0.0) [<25] <0.00>	A (0.0) [<25] <0.00>
Southbound Left	A (7.6) [<25] <0.02>	A (7.6) [<25] <0.01>
Delmar Blvd & Delmar Apartments Main Entrance (unsignalized, Side-Street, STOP)		
Westbound Left	A (9.1) [<25] <0.02>	A (8.9) [<25] <0.06>
Northbound Approach	B (14.7) [<25] <0.16>	B (12.8) [<25] <0.10>
Delmar Blvd & Coffee Shop Entrance (unsignalized, Side-Street, STOP)		
Westbound Left	A (9.7) [<25] <0.11>	A (8.9) [<25] <0.04>
Northbound Approach	C (17.5) [28] <0.27>	B (14.7) [<25] <0.13>

Delay presented in seconds per vehicle

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

m – Volume for 95th percentile queue is metered by upstream signal

As shown, even in the 2040 forecasted operating conditions, many of the study intersections would continue to operate with satisfactory levels of service and manageable delays. All newly proposed site access driveways for the Delcrest Plaza Development and Delmar Mixed Use Development operate favorable with a LOS C or better for both peak hours.

The implementation of a two-way left-turn lane between McKnight Place and the newly proposed Delmar Mixed Use Main Entrance to the west of the site continues to operate favorably in the 2040 forecasted conditions. The northbound approach at Delmar Boulevard and McKnight Place would actually improve to a LOS D in the AM peak hour as opposed to the LOS E forecasted in the 2040 no build scenario due to the provision of a two-way left-turn lane along this section of Delmar Boulevard.

When compared to the 2040 no build operating conditions, neither the Delcrest Plaza development nor the Delmar Mixed Use development appear to significantly impact traffic operations throughout the study area. Levels of service are mostly maintained, with queue lengths at unsignalized intersections limited to approximately 3 vehicles. Again, the unsignalized intersection of Delmar Boulevard at Ladue Crossing Access Road is an exception to this and experiences a queue length equal to approximately 9 vehicles along the northbound approach. However, as previously discussed, the degradation in traffic operations at Ladue Crossing Access Road is not a consequence of the Delcrest Development as only 5 and 10 vehicles are added to that approach during the AM and PM peak hours, respectively. Rather, the degradation is a result of the increase in through traffic on Delmar Boulevard itself, coupled with the close intersection spacing to the signalized intersection at the northbound I-170 ramps/McKnight Road.

As was the case with the 2040 baseline conditions, the northbound and southbound I-170 Ramps at Delmar Boulevard are expected to operate unfavorably during the PM peak hour. Conditions under the 2040 "comprehensive" analysis are not significantly worse when compared to the 2040 no build conditions. For example, the southbound off ramp from I-170 in the 2040 no build scenario is operating at a LOS E with approximately 63.9 seconds of delay in the PM peak hour. Peak queues measure approximately 354 feet and the volume to capacity ratio is 0.88. When the traffic from the various redevelopment proposals is introduced, this approach continues to operate at LOS E in the PM peak hour with 71.8 seconds of delay on average, an increase of less than 7 seconds, and the volume to capacity ratio would only increase by 0.05.

Similarly, the northbound and southbound approach at Delmar Boulevard and the I-170 North Ramp would be expected to operate at a LOS F in the PM peak hours (again, comparable to 2040 no build conditions). Therefore, it does not appear that there is a need for either of the development proposals to mitigate traffic conditions beyond those improvements individually prescribed to each development.

However, as previously stated, it is also evident that the interchange of I-170 with Delmar Boulevard/McKnight Road is demonstrating signs of approaching capacity during the weekday PM peak hour even before considering these development proposals. This condition will continue to degrade as background traffic grows in the area. Given the atypical configuration with the northbound on ramp served via McKnight Road, modifications to this interchange would require completion of a preliminary concept study that evaluated conditions on the interstate itself as well as along the adjacent arterials. However, there are some methods of mitigation that can be considered at both the Northbound and Southbound I-170 Ramps at Delmar Boulevard to help alleviate traffic constraints in the near term, as follows:

1. Encourage multi-modal use to improve accommodations for non-vehicle modes and help offset impact of developments. University City is prime for multi-modal use with easy access to transit and Centennial Greenway.

2. Enforce the existing northbound left turn restriction on the Ladue Crossing Access Drive's approach to Delmar Boulevard during the weekday PM peak period (4 to 6 PM, Monday thru

Friday). The issuance of tickets to offenders should curb the violation of this restriction and therefore improve operations and safety. Should the use of enforcement prove ineffective, then it is suggested that St. Louis County Department of Transportation enter into discussions with the owner of this private road to consider the installation of a median that would limit left turns.

3. Consider a reallocation of the traffic signals' green time to provide additional time to the off ramps. A progression analysis of the signalized intersections along Delmar Boulevard may prove beneficial.

4. Consider the addition of a third lane to the southbound approach to Delmar Boulevard of the I-170 Southbound off ramp. The proposed lane configuration would be two dedicated left-turn lanes and one shared through/right-turn lane. This improvement would decrease the queue at the southbound approach by approximately 180 ft (7 vehicle lengths) and the volume to capacity ratio is decreased by approximately 15%.

5. Widen the northbound approach at Delmar Boulevard and the I-170 Northbound Ramps to provide a dedicated left-turn lane, a dedicated through lane, and a channelized right-turn lane. This improvement decreases the queue at the southbound approach by approximately 180 ft (7 vehicle lengths) and the volume to capacity ratio is decreased by approximately 24%.

6. Evaluate the feasibility of providing a third lane to the southbound approach to Delmar Boulevard from McKnight Road opposite the I-170 Northbound off ramp. The proposed lane configuration would be two dedicated left-turn lanes and one right-turn lane. Additionally, split phasing would be required with the lane configuration. This improvement, if proved to be physically possible, would decrease the queue at the southbound approach by approximately 190 ft (7 vehicle lengths) and the volume to capacity ratio is decreased by approximately 34%. It should be noted that the close proximity to the signalized intersection to the north, coupled with the right-of-way limitations constrains the width in which to accomplish this improvement. For those reasons, this proposed modification may not be feasible.

7. **Given that both the northbound and southbound I-170 off ramps experience failing levels of service with volumes at or approaching capacity, it stands to reason that this interchange may be a candidate for a new configuration in the long term. LochGroup recommends that further study be completed that contemplates various interchange configurations that could serve Delmar Boulevard and McKnight Road in order to mediate these conditions and provide a long term solution to the constrained operating conditions at this interchange.**

It is clear that over the next twenty years there will be a need to improve the operations at this interchange in terms of signal timing and geometrics. As more developments occur and traffic continues to grow, there will be a need for additional capacity to provide additional relief to the road network.

Conclusions

Lochmueller Group has completed the preceding study for the City of University City to address the traffic impacts of three development proposals currently under consideration with the City and identify the relative responsibility for each of the redevelopment proposals to provide identified infrastructure improvements. The three developments currently under consideration by the City are:

- Delcrest Plaza Development
- Delmar Mixed Use Development
- Crown Center Development

The purpose of the traffic impact study was to summarize the forecasted amount of traffic that would be generated by the three currently proposed developments, the impact of the additional trips on the study area road system with respect to each development, the impact of the additional trips on the study area road system when all three developments are complete, and determine if roadway or traffic improvements would be recommended to mitigate the development's impacts and the relative responsibility of each development to provide such improvements.

Based upon the analysis of existing, post development, and twenty-year scenarios, the following conclusions were reached:

- Existing Conditions:
    - Currently, the study intersections generally have favorable conditions during both peak periods with the exception of Delmar Boulevard and the Northbound and Southbound I-170 Ramps. These intersections experience failing, or near failing levels of service in existing conditions.
    - From an access management perspective, it is undesirable how close the intersection of Ladue Crossing Access Road to Delmar Boulevard is to the signalized intersection with the Northbound I-170 Ramps. Left turns from the Ladue Crossing Access Road results in not only traffic operational issues given the lack of adequate space between the intersections, but it also poses a safety issue given the potential for westbound queues to extend past Ladue Crossing Access Drive and the existing eastbound left turn lane on Delmar Boulevard serving the retail center in the northeast quadrant of the intersection. However, this intersection has been in place for many years and a time-based restriction is in place which prohibits left-turns from 4:00-6:00 PM Mondays-Fridays. It is recommended that the intersection be monitored during the PM peak period to ensure enforcement of the time based no left-turn restriction.

- Delcrest Plaza Development:
    - The Delcrest Plaza development includes a 133-room hotel, a 285-unit apartment building, and 4,000 SF of retail/restaurant space.
    - Primary access is provided via one full access driveway on Delcrest Drive, approximately 290 feet south of Delmar Boulevard. A pick-up/drop-off loop is proposed off Delcrest Drive. Trash and other service vehicles would access the site via a new curb cut along Ladue Crossing Access Road, which would not be accessible to the public. The proposed development plans to remove the two existing full access curb cuts along Delmar Boulevard.
    - The proposed Delcrest Plaza development would generate a total of approximately 210 and 245 trips during the weekday morning and evening peak hours, respectively.
    - 2020 operating conditions with the Delcrest Plaza Development in place show that the study intersections are expected to operate favorably with results similar to the existing conditions. The newly proposed site driveway on Delcrest Drive operates at a LOS C or better with queue lengths equal to one vehicle.
    - However, the intersections of Delmar Boulevard and the Northbound and Southbound I-170 Ramps continue to experience failing levels of service, comparable to existing conditions. It is LochGroup's opinion that improvements to this intersection would not be the sole responsibility of this development as this intersection is nearing failing levels of service during existing conditions and the development would add a minimal amount of traffic to the intersections.
    - The proposed access drive onto Delcrest Drive's separation relative to the Walgreen's access drive is not identified on the provided site development plan or within CBB's study. It would be prudent to know the separation between these two drives to ensure that there would be no turning conflicts and that the opposing drives would function as "one" intersection.
    - Additionally, dimensions were not provided for the pick-up/drop-off loop proposed along Delcrest Drive. It would be prudent to know the dimensions of the proposed pick-up/drop-off loop to ensure maneuverability; thereby minimizing the potential for spillbacks onto Delcrest Drive. It is recommended that the loop be designed to provide for a bypass lane to ensure that vehicles can maneuver around one another.
    - The proposed service access on Ladue Crossing Access Road does not appear to meet sight distance requirements per the American Association of State Highway Transportation Officials (AASHTO). Currently, the fence on the Crown Center property is contributing to the limited sight distance. It is recommended that the petitioner's engineer provide sight distance calculations/diagrams for the ultimate proposed location prior to issuance of a permit.
    - **Overall, no mitigation as a result of Delcrest Plaza was recommended.**

- Delmar Mixed Use Development:
    - The development is to include approximately 258 apartment units with integrated structured parking and a separate 2,098 SF coffee shop with drive-through service.
    - Primary access is proposed via two new full-access driveways on Delmar Boulevard. As part of the development plan, McKnight Place would be realigned to remove the slight curve in the roadway near Delmar Boulevard.
    - The proposed Delmar Mixed Use development would generate a total of approximately 185 and 155 new trips during the weekday morning and evening peak hours, respectively.
    - 2020 operating conditions with the Delmar Mixed Use Development in place show that the study intersections are expected to operate favorably with results similar to the existing conditions. The newly proposed site driveways on Delmar Boulevard operate at a LOS C or better with queue lengths equal to one vehicle or less.
    - However, the intersections of Delmar Boulevard and the Northbound and Southbound I-170 Ramps continue to experience failing levels of service, comparable to existing conditions. It is LochGroup's opinion that improvements to this intersection would not be the sole responsibility of this development as this intersection is nearing failing levels of service during existing conditions.
    - The addition of a two-way left-turn lane along Delmar Boulevard adjacent to the development significantly improves conditions along the northbound approach at Delmar Boulevard and McKnight Place. **For this reason, LochGroup agrees with CBB's recommendation of a two-way left-turn lane between McKnight Place and the newly proposed Delmar Apartments Main Entrance to the west of the site. This improvement should be the responsibility of the Delmar Mixed Use Development.**
    - The proposed site plan does not provide cross access to the existing Gatesworth Community. Cross access is vital as tenants of the Gatesworth Community should be able to access the proposed coffee shop without having to rely upon Delmar Boulevard and thereby add unnecessary turning movements. **LochGroup recommends providing cross access between the site and the Gatesworth community in order to improve access and circulation.**
    - All proposed intersections along Delmar Boulevard should conform to the sight distance requirements set forth by the American Association of State Highway and Transportation Officials (ASHTO). Furthermore, as part of the design process, care should be given to ensure that signage and/or landscaping does not pose sight distance limitations at any of the proposed drive locations.
    - **The proposed Delmar Mixed-Use development, in and of itself, does not significantly impact traffic operations along the surrounding road network. Other than the provision of a two-way left-turn lane between McKnight Place and the newly proposed Delmar Apartments Main Entrance to the west of the site, and the provision of cross access to the Gatesworth Community no additional mitigation as a result of the Delmar Mixed Use Development was recommended.**

- Crown Center Development:
    - Currently, the Crown Center has an existing 244-unit multi-family residential development for senior living with associated accessory services on site. Therefore, the "redevelopment" would essentially be an update to the existing facilities without changing the use, significantly modifying the number of units provided, or the site's access. **Therefore, the redevelopment of Crown Center would not contribute any additional traffic to the surrounding road system as it is already captured in the existing conditions.**

- 2020 and 2040 Comprehensive Analysis:
    - Many of the study intersections would continue to operate with satisfactory levels of service and manageable delays. All newly proposed site access driveways for the Delcrest Plaza Development and Delmar Mixed Use Development are expected to operate favorably with a LOS C or better for both peak hours.
    - Overall, neither the Delcrest Plaza development nor the Delmar Mixed Use development appear to significantly impact traffic operations throughout the study area. Levels of service are mostly maintained, with queue lengths at unsignalized intersections limited to approximately two vehicles.
    - Again, the northbound and southbound I-170 Ramps operate unfavorably. However, conditions under the "comprehensive" analysis are not significantly worse than those under the existing conditions. **Therefore, it does not appear that there is a need for any of the development proposals to mitigate traffic conditions beyond those improvements individually prescribed to each development.**

While mitigation recommendations at both the Northbound and Southbound I-170 Ramps at Delmar Boulevard may not be necessary at this time nor attributable to the developments under consideration in this study, as the area continues to develop and additional traffic is introduced, it will be necessary to provide additional relief to the road network. LochGroup offers the following recommendations:

1. Encourage multi-modal use to improve accommodations for non-vehicle modes and help offset impact of developments. University City is prime for multi-modal use with easy access to transit and Centennial Greenway.

2. Enforce the existing northbound left turn restriction on the Ladue Crossing Access Drive's approach to Delmar Boulevard during the weekday PM peak period (4 to 6 PM, Monday thru Friday). The issuance of tickets to offenders should curb the violation of this restriction and therefore improve operations and safety. Should the use of enforcement prove ineffective, then it is suggested that St. Louis County Department of Transportation enter into discussions with the owner of this private road to consider the installation of a median that would limit left turns.

3. Consider a reallocation of the traffic signals' green time to provide additional time to the off ramps. A progression analysis of the signalized intersections along Delmar Boulevard may prove beneficial.

4. Consider the addition of a third lane to the southbound approach to Delmar Boulevard of the I-170 Southbound off ramp. The proposed lane configuration would be two dedicated left-turn lanes and one shared through/right-turn lane. This improvement would decrease the queue at the southbound approach by approximately 100 ft (4 vehicle lengths) and the volume to capacity ratio is decreased by approximately 14% during the 2020 comprehensive conditions.

5. Widen the northbound approach at Delmar Boulevard and the I-170 Northbound Ramps to provide a dedicated left-turn lane, a dedicated through lane, and a channelized right-turn lane. This improvement decreases the queue at the southbound approach by approximately 160 ft (6 vehicle lengths) and the volume to capacity ratio is decreased by approximately 19% during the 2020 comprehensive conditions.

6. Evaluate the feasibility of providing a third lane to the southbound approach to Delmar Boulevard from McKnight Road opposite the I-170 Northbound off ramp. The proposed lane configuration would be two dedicated left-turn lanes and one right-turn lane. Additionally, split phasing would be required with the lane configuration. This improvement, if proved to be physically possible, would decrease the queue at the southbound approach by approximately 150 ft (6 vehicle lengths) and the volume to capacity ratio is decreased by approximately 32% during the 2020 comprehensive conditions. It should be noted that the close proximity to the signalized intersection to the north, coupled with the right-of-way limitations constrains the width in which to accomplish this improvement. For those reasons, this proposed modification may not be feasible.

7. **Given that both the northbound and southbound I-170 off ramps experience failing levels of service with volumes at or approaching capacity, it stands to reason that this interchange may be a candidate for a new configuration in the long term. LochGroup recommends that further study be completed that contemplates various interchange configurations that could serve Delmar Boulevard and McKnight Road in order to mediate these conditions and provide a long term solution to the constrained operating conditions at this interchange.**

This traffic study adequately describes the forecasted traffic conditions that should be expected as a result of the three development proposals currently under consideration with the City of University City. Please contact our office at (314) 446-3791 if you have any questions or comments concerning this report.

Completed by Lochmueller Group, Inc.