St. Louis Lambert International Airport Terminal 2 Transportation Study

St. Louis, Missouri

October 2018

CBB TRANSPORTATION ENGINEERS+PLANNERS

prepared for:

STL ST. LOUIS LAMBERT INTERNATIONAL AIRPORT™

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EXECUTIVE SUMMARY

CBB has completed a transportation study for St. Louis Lambert International Airport to enhance traffic flow and circulation at Terminal 2. The recent increase in the airport passenger traffic and the associated increase in vehicular traffic volumes at Terminal 2 have resulted in congested traffic conditions. The purpose of this study was to evaluate the existing vehicular and pedestrian operations at Terminal 2 and to recommend improvements to enhance these operations.

Existing Conditions

Inadequate stacking capacity in the passenger pick-up area, departures area drop-off parking space constraints, lane usage and utilization at signalized intersections, and Terminal 2 Garage capacity were identified as issues and constraints that would need to be addressed.

Recommendations

Three short-term options – Options A, B, and C; and one long-term option, Option D, were recommended.

Option A - Arrivals Area Modifications includes the addition of a new TNC pick-up area, relocation of Off-Airport Parking Shuttle Area, installation of Rapid Rectangular Flashing Beacons (RRFB) for Terminal 2 Garage pedestrian crosswalk in the Arrivals Area, and relocation of CBP parking area. The preliminary cost estimate for Option A is $500,000. It is expected that Option A would eliminate sustained queuing and backups to Lambert International Boulevard originating in the Arrivals Area; and would significantly minimize sporadic congestion in the Arrivals Area.

Option B - New DMS Board includes the addition of a Dynamic Message Sign (DMS) near the Air Flight Drive/Lambert International Boulevard interchange. The proposed sign would provide information on Terminal 2 Garage and Parking Lot E availability before vehicles reach Terminal 2. Providing a DMS before vehicles arrive at Terminal 2 allows for vehicles to properly find another location to park if the Terminal 2 Garage or Parking Lot E are full. The preliminary cost estimate for Option B is $125,000.

Option C - Departures Area Modifications is recommended to provide short-term congestion relief for the Departures Area by providing eight (8) additional angled-parking spaces for drop-off vehicles, which will increase the total amount of angled-parking spaces to twenty-one (21). In addition to physical modifications, Option C recommends providing two additional active traffic control personnel to better manage passenger drop-off operations. It is expected that Option C would eliminate sustained queuing and significantly minimize sporadic queuing in the departures area. The preliminary cost estimate for Option C is $100,000.

Recommended long-term improvements, ***Option D - Intersection Enhancements*** includes improvements at Lambert International Boulevard and Terminal 2 Drive signalized intersection, intersection modifications and new restrictions at Terminal 2 Drive and Air Cargo Road

intersection, reconfiguration of Arrivals Area entrance lane to provide two entering lanes north of Air Cargo Road signalized intersection, and two additional entrances to Terminal 2 Garage Entrance. Option D is expected to provide significant reduction in queues and travel delay; and significantly improve traffic flow and travel lane utilization at Terminal 2 and along Lambert International Boulevard. The preliminary cost estimate for Option D is $1,500,000. The two additional garage entrances could be constructed independent of each other.

In addition to the above recommendations, increasing parking capacity at Terminal 2 Garage should be considered for long-term operations.

INTRODUCTION

CBB has completed a transportation study for St. Louis Lambert International Airport to enhance traffic flow and circulation at Terminal 2. The recent increase in the airport passenger traffic and the associated increase in vehicular traffic volumes at Terminal 2 have resulted in congested traffic conditions. The purpose of this study was to evaluate the existing vehicular and pedestrian operations at Terminal 2 and to recommend improvements to enhance these operations.

Figure 1 illustrates the general location of Terminal 2 at the St. Louis Lambert International Airport. Passenger operations at Terminal 2 are separated into two different areas; the Departures Area and the Arrivals Area. The Departures Area and the Arrivals Area are grade separated with the Departures Area on the upper deck and the Arrivals Area on the lower deck. Additionally, a parking garage is provided for Terminal 2 (Terminal 2 Garage) with the garage entrance only accessible via the Arrivals Area entrance lane. The garage exit is located on Lambert International Boulevard at a signalized intersection.

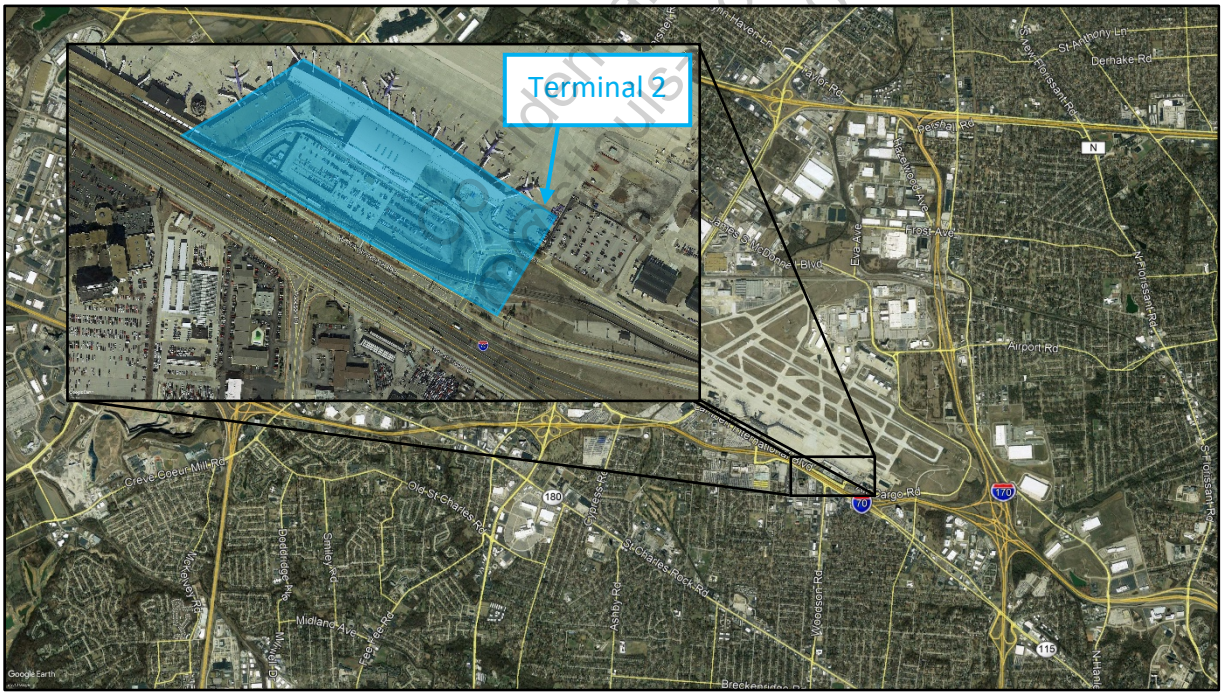

Figure 1: Site Location Map

EXISTING CONDITIONS

Terminal 2 Access

Access to Terminal 2 is provided primarily from Lambert International Boulevard via Terminal 2 Drive. Lambert International Boulevard intersects Terminal 2 Drive at a signalized intersection. Air Cargo Road intersects with the Terminal 2 Drive and Departures/Arrivals Entrance Lanes at a signalized intersection. An aerial view of the intersections is shown in **Figure 2**.

The eastbound Lambert International Boulevard approach at Terminal 2 Drive provides two left-turn lanes and two through lanes. The left-turn lanes operate under protected phasing. The westbound Lambert International Boulevard approach provides two through lanes and two right-turn lanes. The southbound Terminal 2 Drive approach provides a left-turn lane and a right-turn lane.

The northbound Terminal 2 Drive approach at the Air Cargo Road signalized intersection provides two through lanes and a right-turn lane; one of the northbound through lanes provides access to the Departures Area and the other through lane provides access to the Arrivals Area. The westbound Air Cargo Road approach provides one shared left-turn/right-turn lane to the Departures Area and one separate right-turn lane to the Arrivals Area.

Access from Terminal 2 is provided directly onto Lambert International Boulevard. The Terminal 2 Departures Area/Arrivals Area Exit lanes intersect Lambert International Boulevard at a signalized intersection. An aerial view of the intersection is shown in **Figure 3**.

The eastbound and westbound Lambert International Boulevard approaches at Terminal 2 Departures Area/Arrivals Area Exit intersection provide two through lanes in each direction. The southbound Terminal 2 Departures Area/Arrivals Area Exit approach provides two left-turn lanes and two right-turn lanes. The two middle lanes from the upper deck Departures Area Exit are physically separated from the Arrivals Area Exit lanes because of difference in grade while approaching Lambert International Boulevard.

Due to the elevation change from the Departures Area to Lambert International Boulevard, an exit ramp is provided to access the signalized intersection. The exit ramp provides a separated left-turn and right-turn lane for vehicles leaving the Departures Area onto Lambert International Boulevard. Vehicles leaving the Arrivals Area are provided with a separate right-turn and a left-turn lane. The right-turn lane is located directly east of the exit ramp; and the left-turn lane is located west of the exit ramp. The location of these lanes allows for proper dual left-turn and right-turn lane alignments for the southbound Terminal 2 Departures Area/Arrivals Area Exit approach.

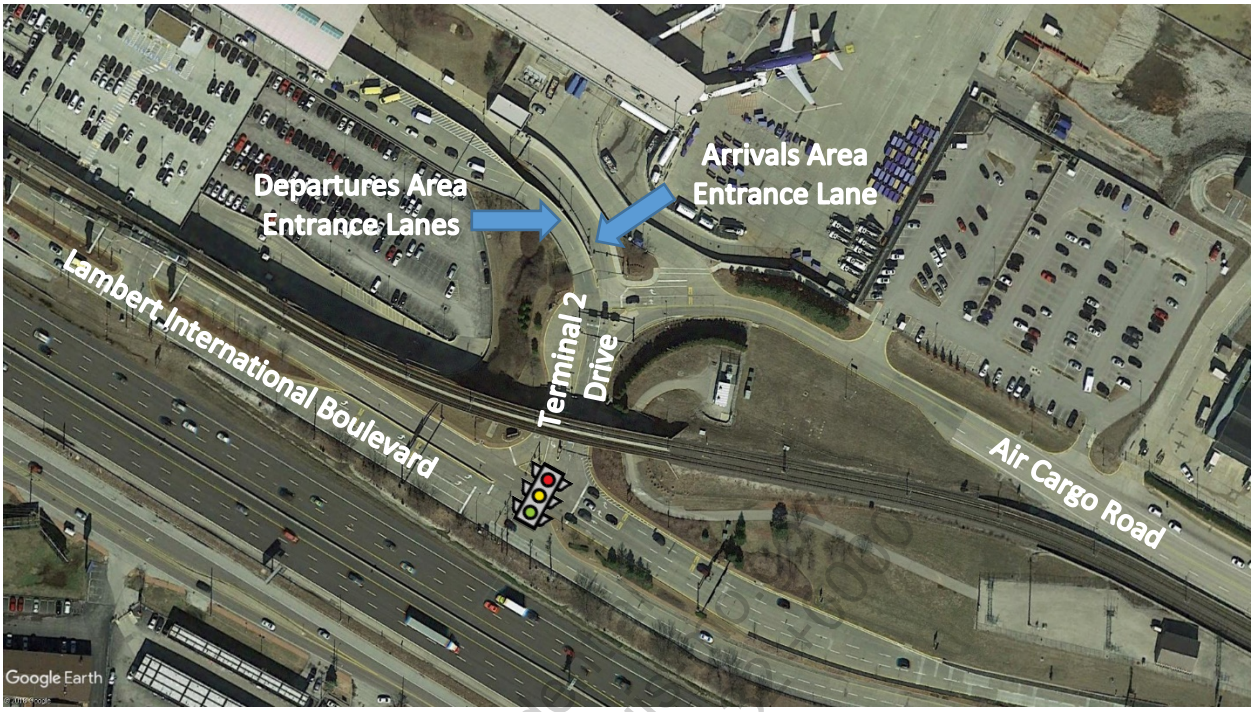

Figure 2: Aerial View of Terminal 2 Entrance

Figure 3: Aerial View of Terminal 2 Exit

The Terminal 2 Garage Exit provides direct access to Lambert International Boulevard at a signalized intersection. An aerial view of the intersection is shown in **Figure 4**.

The eastbound and westbound Lambert International Boulevard approaches at this signalized intersection provide two through lanes in each direction. The southbound Terminal 2 Garage Exit approach provides two left-turn lanes and two right-turn lanes.

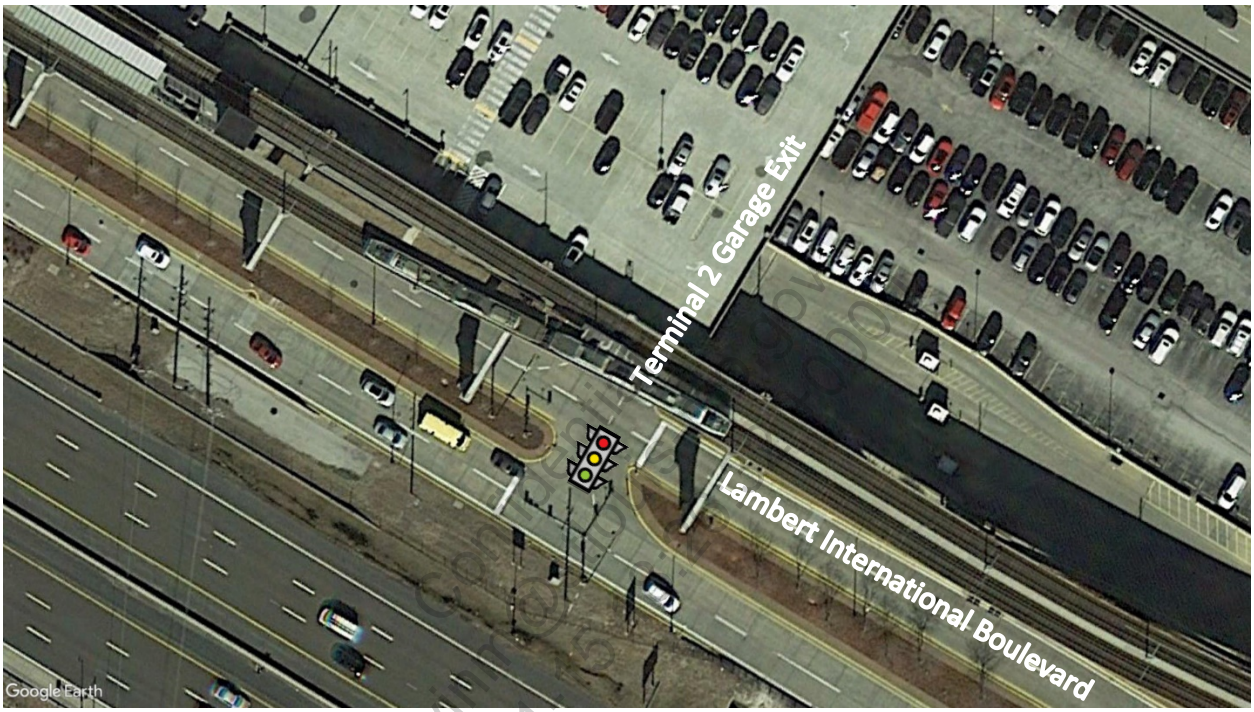

Figure 4: Aerial View of Terminal 2 Garage Exit

Departures Area Observations

Observations at Terminal 2 Departures Area were completed on Thursday, May 3rd; Sunday, May 6th; and Monday, May 7th, from 6 a.m. to 10 p.m. each day. The purpose of the observations was to identify the existing vehicular and pedestrian operations.

Figure 5 illustrates the roadway geometrics for the Departures Area. Within the departures area, three (3) entrances are provided to the terminal, and a curbside Bag-drop Area is provided near the eastern Terminal entrance. Furthermore, one inside lane and two outside lanes are provided for vehicles. The right outside lane provides access to fifteen (15) angled passenger drop-off spaces. The left outside lane serves as a drive lane. The angled passenger drop-off spaces are separated into two groups by a raised median that provides refuge for pedestrians crossing the outside and inside lanes between the Terminal 2 Garage and Terminal 2. The angled passenger drop-off spaces are utilized for passenger drop-offs; and the inside lane serves as a pull-out drive lane for these drop-off vehicles. It should be noted that a large portion of pavement situated before the angled passenger drop-off spaces begin is utilized as a drop-off location for shuttles. A large raised median is provided for passengers from the shuttle drop-off area to the Terminal 2 entrances.

During observations at the Departures Area, a preference by vehicles to drop-off passengers at the east end of the angled passenger drop-off spaces was noticed; reflecting a tendency to drop-off at the first possible opportunity and also in close proximity to the Bag-drop Area. This leads to many parking spaces being double stacked, which creates a queue that spills into the right outside lane and back to the entrance of the Departures Area. Furthermore, it was observed that several drivers did not recognize that the inside lane serves as a pull-out drive lane for drop-off vehicles; and drivers were observed to reverse out of the angled-parking spaces. Additionally, it was observed that once the drop-off location for shuttles was occupied and for added convenience, incoming shuttles would instead drop off passengers at the raised median crosswalk between the Terminal 2 Garage and Terminal 2.

As previously mentioned, there are fifteen angled passenger drop-off spaces provided in the Departures Area, and the curbside Bag-drop Area is located near the first two spaces on the east side of the Arrivals Area. To provide enough storage for passengers to queue at the curbside Bag-drop desk, two angled-parking spaces are blocked off by concrete barriers. By blocking these two spaces, it was observed that only thirteen (13) angled passenger drop-off spaces are being utilized.

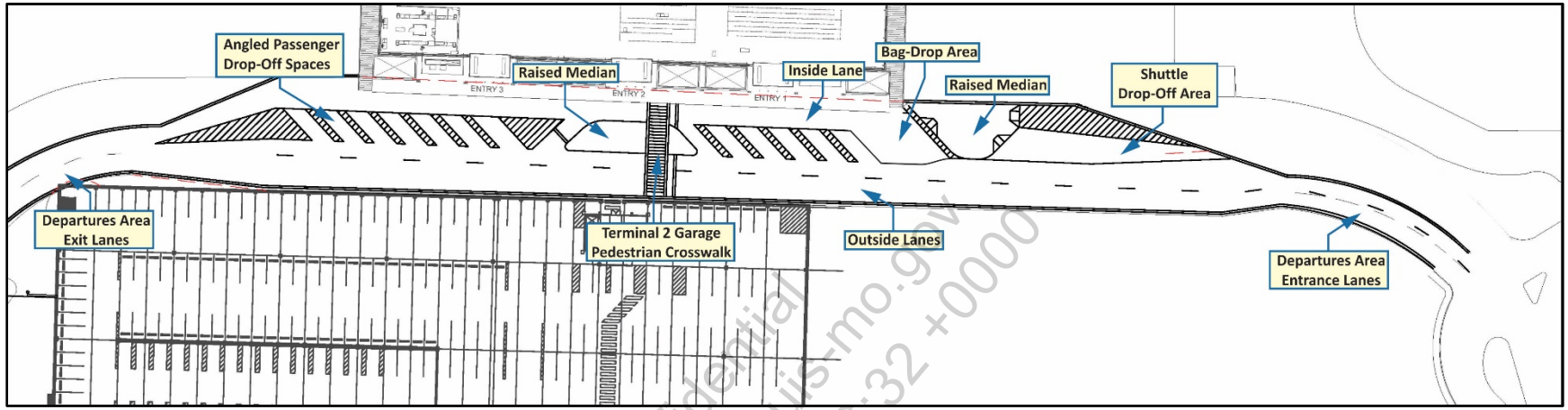

Figure 5: Departures Area (Upper Drive)

Arrivals Area Observations

Observations at Terminal 2 Arrivals Area were completed on Thursday, May 3rd; Sunday, May 6th; and Monday, May 7th, from 6:00 a.m. to 10:00 p.m. each day. The purpose of the observations was to identify the existing vehicular and pedestrian operations.

Figure 6 illustrates the roadway geometrics for the Arrivals Area. Within the Arrivals Area, six (6) entrances are provided into the terminal. Two inside lanes and three outside lanes are provided for vehicles. On the west side of the Arrivals Area, the inside and outside lanes are at the same elevation, but on the east side, the lanes are at different elevations. The outside lanes are at a lower elevation than the inside lanes; thus, no pedestrian crosswalk is currently provided on the east end of the Terminal. The inside and outside lanes are separated by a raised median.

The right inside lane provides parking spaces for the Hotel/Motel, Terminal, Airport Parking, and Off-Airport Parking shuttles. The left inside lane serves as a drive lane. Additionally, two pedestrian crosswalks are provided to cross the two inside lanes between the raised median and Terminal 2. The west pedestrian crosswalk connects the Passenger/Transportation Network Companies (TNC) pick-up area to the terminal, and the east pedestrian crosswalk connects the Rental Car Shuttles area to the terminal.

The left outside lane provides access to the Terminal 2 Garage entrance. This lane is also used by taxis picking up passengers at the terminal inside the Terminal 2 Garage. During the times when Terminal 2 Garage is full, this lane is operated manually by an attendant to allow taxis to enter the garage; while blocking passenger vehicles from entering the garage. The right outside lane provides parking spaces for the Rental Car Shuttles and Passenger/TNC pick-up areas. The Rental Car Shuttle Area and the Passenger/TNC pick-up areas are separated by a pedestrian crosswalk between the Terminal 2 Garage and the raised median. The raised median provides refuge to pedestrians waiting for the vehicles to arrive at the Rental Car Shuttle Area and the Passenger/TNC pick-up areas. The center outside lane serves as a drive lane.

Arrivals Area constraints were identified based on observations completed. The first constraint is low stacking capacity for the passenger/TNC pick-up area. The demand created for this area is very high when vehicles are attempting to pick-up passengers. It was observed that numerous passengers utilized TNC services to be picked up from the terminal. The vehicles attempting to the reach the passenger pick-up area create a queue in the middle outside lane, which is intended to operate as a drive lane. This queue increases due to vehicles attempting to reach the Terminal 2 garage entrance and the rental car shuttles attempting to pick up passengers. All these factors lead to the queue reaching and blocking the signalized intersection of Air Cargo Road and Departures/Arrivals Entrance lanes and the signalized intersection of Terminal 2 Drive and Lindbergh International Boulevard for several minutes. During periods of significant congestion, this backup was observed to extend to and impact traffic operations on Lambert International Boulevard.

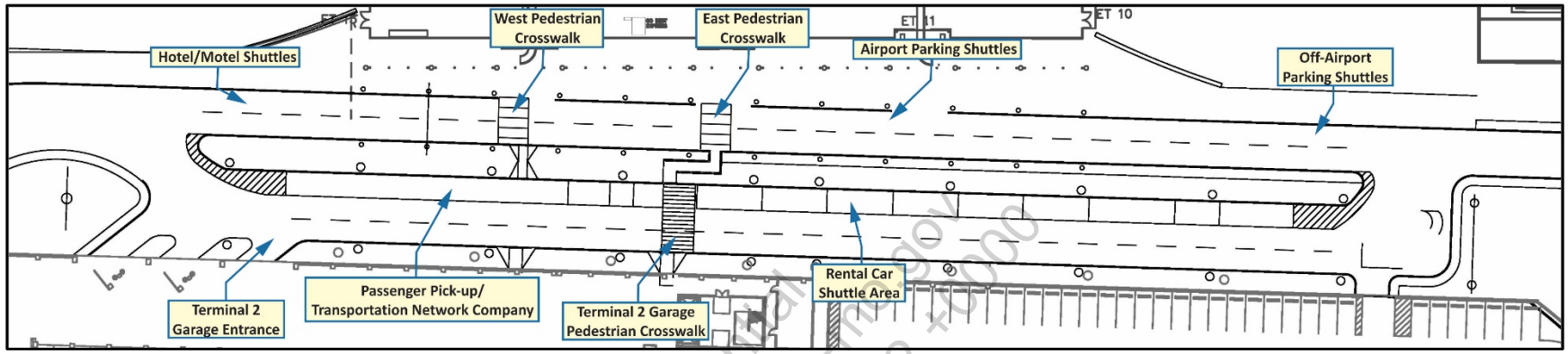

Figure 6: Arrivals Area (Lower Drive)

Flight Arrivals & Departures Times

The flight arrivals and departures times for Terminal 2 during the observation days were reviewed to assess the impact on the observed congestion in the Arrivals Area and the Departures Area.

Figure 7 summarizes the flight arrival times for Terminal 2 on Monday, May 7, 2018. There are periods in which multiple flights arrive during a 20-minute to 30-minute time frame. The arrival of multiple flights in a short time frame causes the congestion seen in the Arrivals Area. The increase in the number of passengers needing to be picked up causes an increase in vehicles in the Arrivals Area. **Figure 8** summarizes the flight departure times for Terminal 2 on Monday, May 7, 2018. Like the pattern seen in the flight arrival times, there are periods during which multiple flights depart during a 20-minute to 30-minute time frame. The grouping of numerous flight departures impacts the demand in the number of passengers being dropped off in the Departures Area

Pedestrian Crosswalks

The Departures Area has a pedestrian crosswalk between the terminal and the Terminal 2 Garage that crosses the inside and outside lanes. The Arrivals Area has three pedestrian crosswalks; two crosswalks between the terminal and the raised median crossing the inside lanes, and one crosswalk between the Terminal 2 Garage and the raised median crossing the outside lanes.

A pedestrian count was completed at all four pedestrian crosswalk locations on Thursday, August 16, 2018, from 9:00 a.m. to 1:00 p.m. Based on the count, it was observed that peak pedestrian crossings occur between 9:00 a.m. to 10:00 a.m. in the Departures Area and between 9:15 a.m. to 10:15 a.m. in the Arrivals Area. Peak hour pedestrian crossings at the four crosswalks are listed below:

- Upper Drive Departures Area Crosswalk – 125 pedestrians per hour
- Lower Drive Arrivals Area Terminal 2 Garage Crosswalk – 179 pedestrians per hour
- Lower Drive Arrivals Area West Crosswalk – 177 pedestrians per hour
- Lower Drive Arrivals Area East Crosswalk – 351 pedestrians per hour

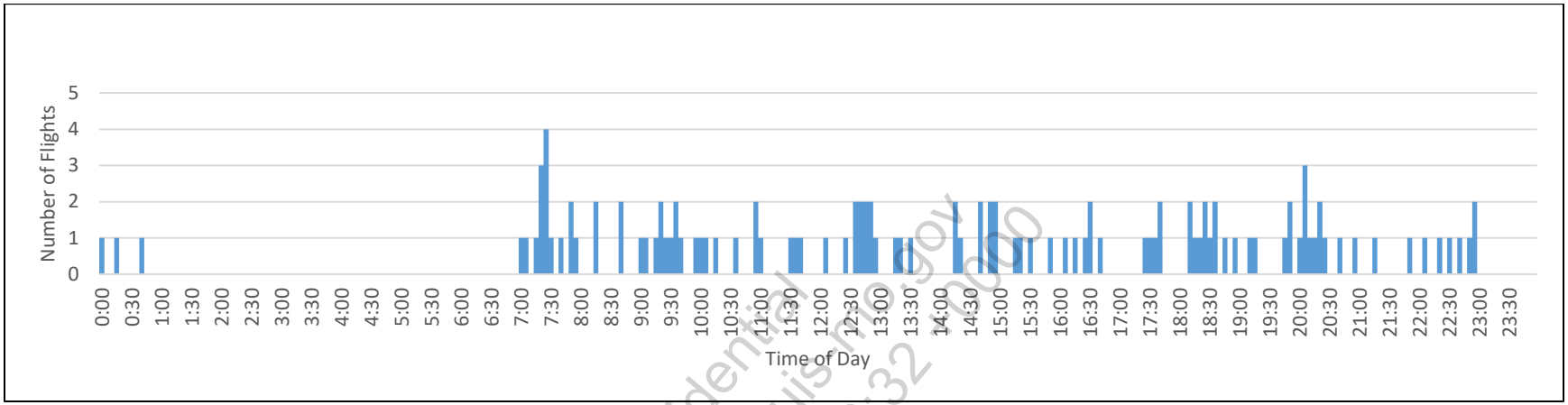

Figure 7: Arrival Flights Per 5 Minutes on Monday, May 7, 2018

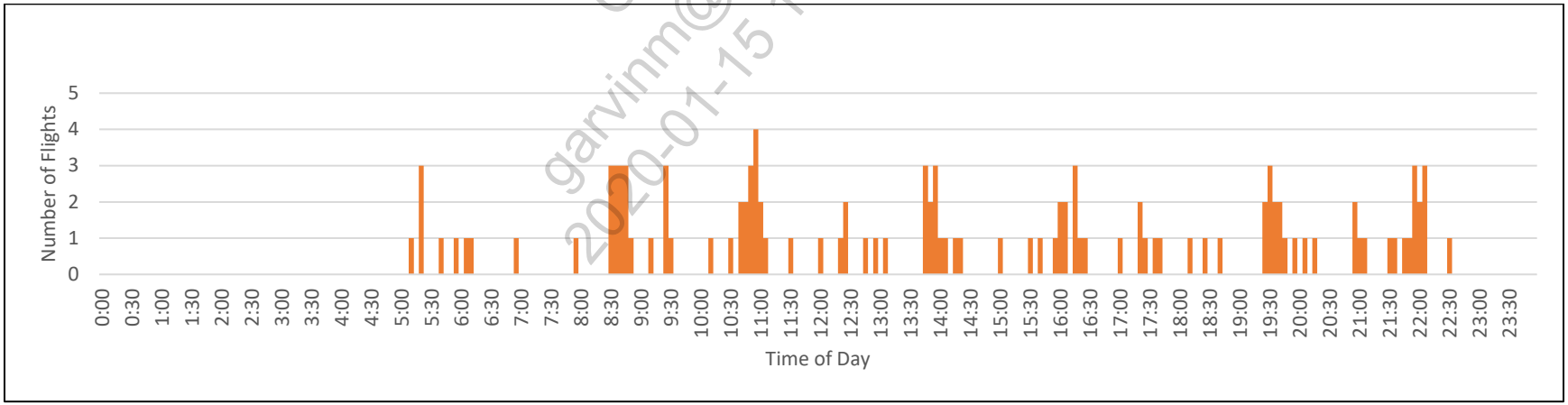

Figure 8: Departure Flights Per 5 Minutes on Monday, May 7, 2018

Vehicle Composition Count

A vehicle composition count was performed on Thursday, June 14, 2018, from 7:00 a.m. to 10:00 a.m. and Sunday, June 24, 2018, from 12:00 p.m. to 3:00 p.m. at the Departures Area and the Arrivals Area. **Table 1** summarizes the vehicle composition count collected during these days.

Passenger Cars and Off-Airport Parking Shuttles are heavy in both the Departures Area and the Arrivals Area. Rental Car Shuttles are heavy in the Arrivals Area and low in the Departures Area; because these shuttles' pick-up and drop-off operations occur in the Arrivals Area. The number of Hotel/Motel Shuttles and Airport Shuttles are moderate for both the Departures Area and the Arrivals Area.

Table 1: Vehicle Composition Count

Date: **Time:**		**Thursday, June 14, 2018** **7:00 AM – 10:00 AM**		**Sunday, June 24, 2018** **12:00 PM – 3:00 PM**	
Location:		**Departures Area**	**Arrivals Area**	**Departures Area**	**Arrivals Area**
Cars		665	633	1015	834
Hotel/Motel Shuttles		39	42	24	55
Rental Car Shuttles		2	169	8	142
Off-Airport Parking Shuttles		141	134	133	151
Airport Shuttles	Terminal	3	31	2	26
	Parking Lot A	10	14	5	10
	Parking Lot B	1	6	6	11
	Parking Lot C	22	10	18	25
	Parking Lot D	8	9	13	12
	Parking Lot E	0	8	0	8

Terminal 2 Parking Garage

The occupancy of the Terminal 2 Garage was examined during the observations days as well as a few days before the observations began. The total number of available parking spaces within the Terminal 2 Garage is 1,058 spaces (1,032 public spaces and 26 reserved spaces). The entries and exits for the Terminal 2 Garage were examined and summarized in **Figures 9** and **10**.

Terminal 2 Garage was observed to be at full occupancy during numerous hours of the day on Tuesday and Wednesday. The busiest hours were between 7:00 a.m. and 7:00 p.m., when the overall parking occupancy was between 92% and 100%. On Thursday, the busiest hours were between 9:00 a.m. and 5:00 p.m., when the overall parking occupancy was between 92% and 100%. During the hours of observation on Friday, Saturday, and Sunday, the parking garage did not reach full occupancy. On Monday, the busiest hours were between 9:00 a.m. and 11:00 p.m., when the overall parking occupancy was between 92% and 100%.

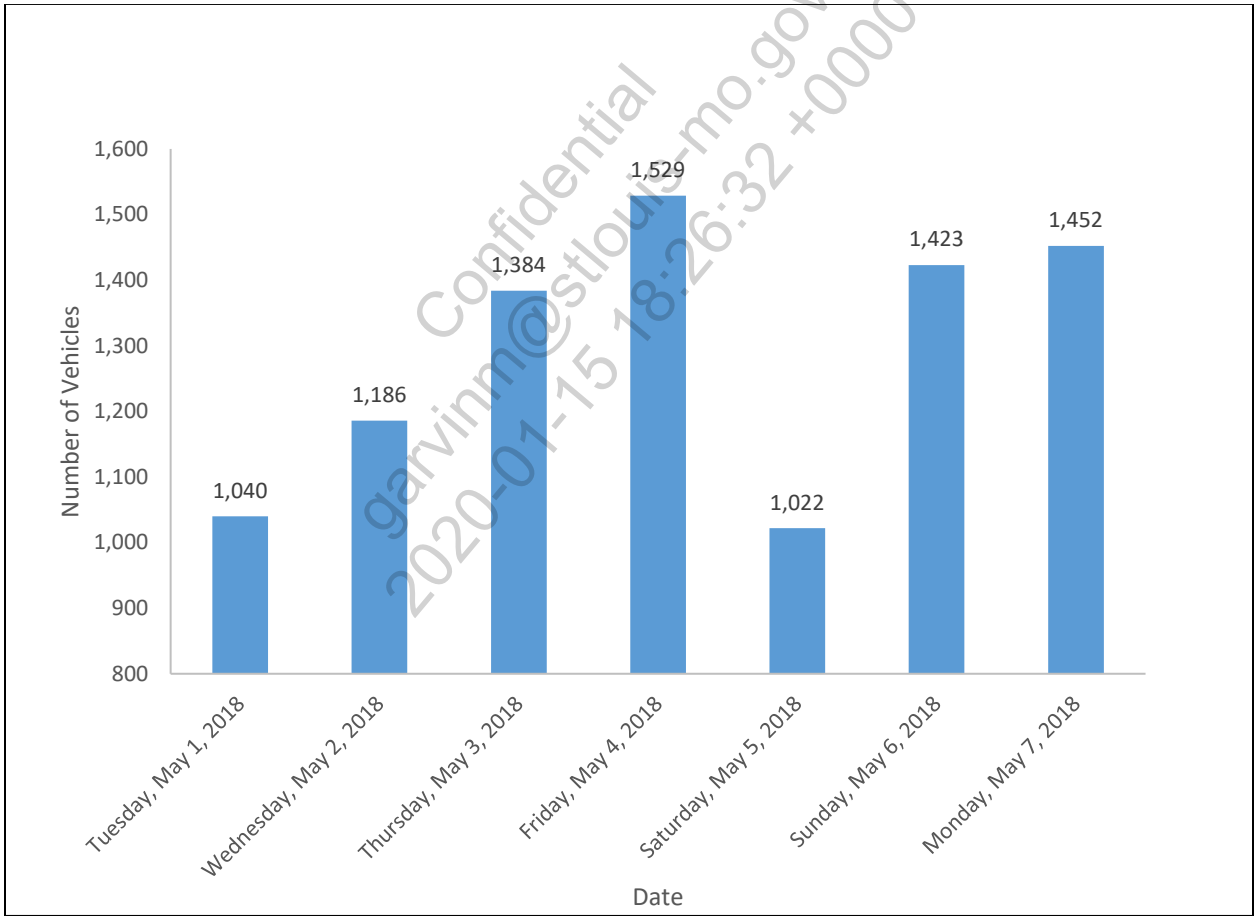

Figure 9: Total Number of Vehicles Entering Terminal 2 Parking Garage Per Day

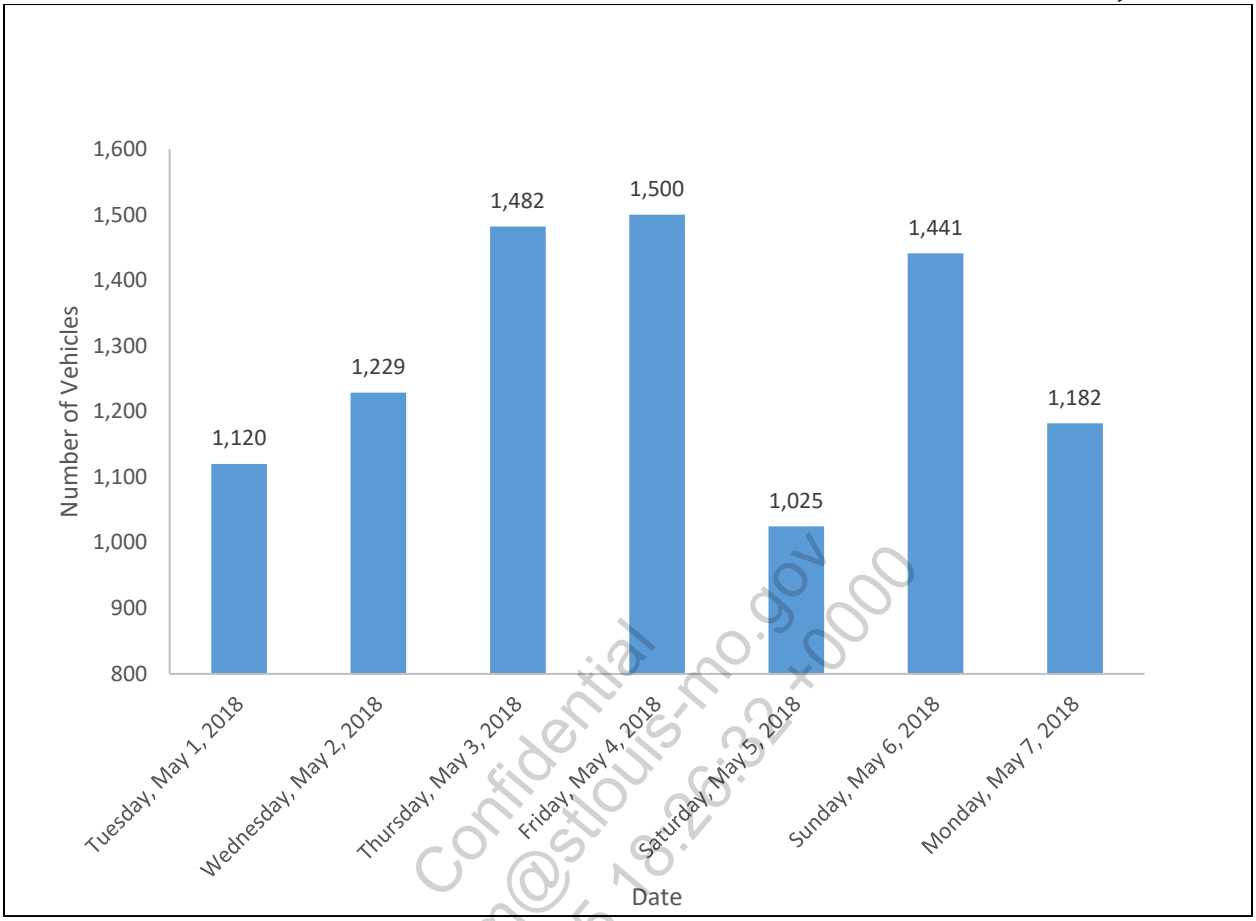

Figure 10: Total Number of Vehicles Exiting Terminal 2 Parking Garage Per Day

Parking Lot E

The occupancy of Parking Lot E was examined during the observations days as well as a few days before the observations began. The entries and exits for Parking Lot E were examined and summarized in **Figures 11** and **12**. The total number of available parking spaces within Parking Lot E is 248 spaces (all public spaces).

Parking Lot E was observed to be at full occupancy during numerous hours on Tuesday and Wednesday. The busiest hours were between 7:00 a.m. and 7:00 p.m., with the overall parking occupancy between 86% and 100%. On Thursday, the busiest hours were between 1:00 p.m. and 7:00 p.m., when the overall parking occupancy was between 87% and 95%. On Friday, Saturday, and Sunday, the parking garage did not reach full occupancy. On Monday, the busiest hours were between 1:00 p.m. and 11:00 p.m., when the overall parking occupancy was between 95% and 100%.

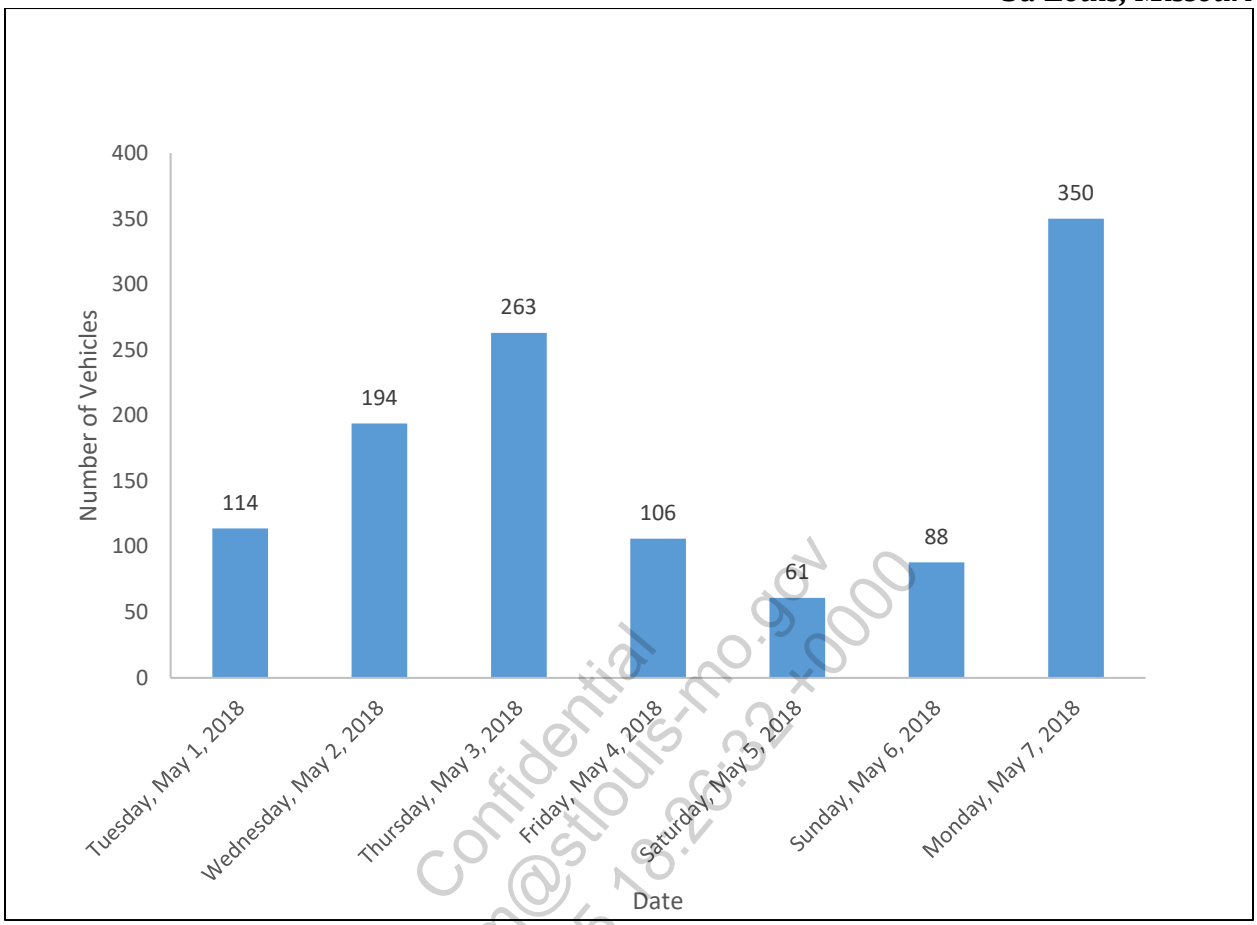

Figure 11: Total Number of Vehicles Entering Parking Lot E per Day

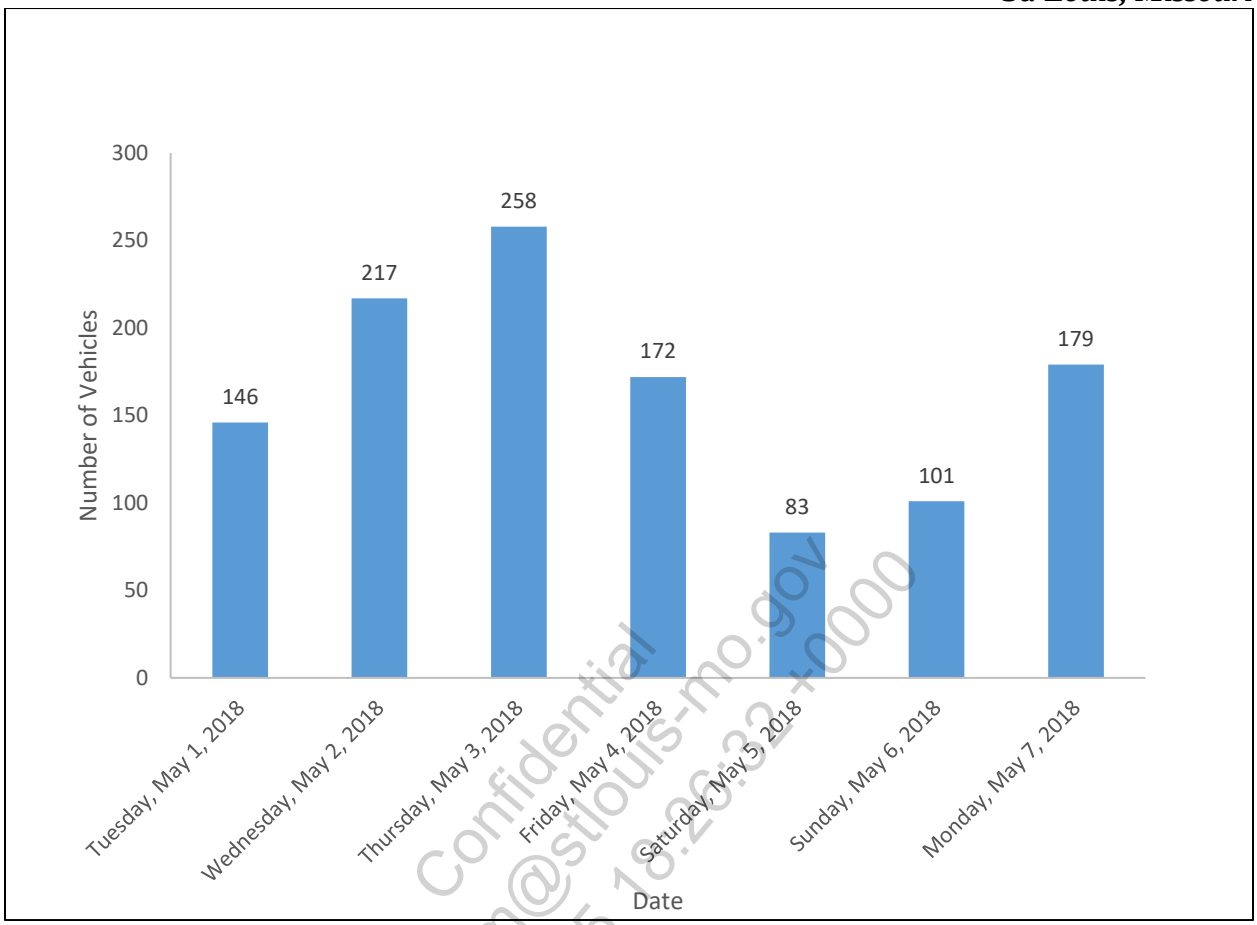

Figure 12: Total Number of Vehicles Exiting Parking Lot E per Day

Additional data charts and tables are shown in Appendix A.

Summary of Existing Constraints

Based on the data analysis and observations, the following is a summary of existing issues and constraints:

- Passenger/TNC pick-up area has a limited number of available spaces; while the demand was observed to exceed available spaces during busy flight arrival periods.
- Queuing from Passenger/TNC pick-up area blocks the outside lanes in the Arrivals Area; and during periods of sustained congestion, the queue backups extend beyond the signalized intersection of Lambert International Boulevard and Terminal 2 Drive and impact traffic operations on Lambert International Boulevard.
- While approaching the Departures Area from Terminal 2 Drive, a visual bottleneck exists resulting from the vertical profile of the Departures Area Entrance lanes and the location of the concrete barriers adjacent to the Bag-drop Area.
- Drivers prefer to predominantly use the angled-parking spaces on the east end of the Departures Area.
- Double stacking of angled-parking spaces.
- Driver confusion and compliance issues related to the existing angled-parking spaces and tendency to reverse out of the parking spaces instead of pulling forward to exit.
- Poor visibility and advance notice at Terminal 2 Garage crosswalk in the Arrivals Area.
- Lack of advance notice of Terminal 2 Garage and Parking Lot E availability for vehicles entering through Air Flight Drive.

RECOMMENDED IMPROVEMENT OPTIONS

Based on analysis and observations, inadequate stacking capacity in the passenger pick-up area, departures area parking space constraints, lane usage and utilization at signalized intersections, and Terminal 2 Garage capacity were identified as issues and constraints that would need to be addressed. Multiple preliminary improvement options were developed and discussed with staff and leadership at the Airport.

Based on evaluations and additional feedback from the St. Louis Lambert International Airport officials, the following recommendations were developed for the Departures Area, Arrivals Area, and roadway system. The recommendations are grouped into Short-Term and Long-Term options. Conceptual layout exhibits illustrating the recommended improvement options and preliminary cost estimates are included in this section of the report. In addition to the recommended options, other options for long-term consideration are also included at the end of this section. The conceptual layouts and cost estimates should be refined during preliminary engineering and design stages.

Short-Term Recommendations

Option A - Arrivals Area Modifications includes:

- new TNC pick-up area east of the terminal building
- relocation of Off-Airport Parking Shuttle Area
- installation of Rapid Rectangular Flashing Beacons (RRFB) for Terminal 2 Garage pedestrian crosswalk in the Arrivals Area
- relocation of CBP parking area

Exhibit A illustrates the conceptual layout of the proposed Option A. The proposed addition of the new TNC pick-up area would utilize the currently vacant grass area on the east side of the terminal building. The new TNC pick-up area would provide ten (10) parallel parking spaces dedicated only for the TNC pick-up vehicles. To provide access to the new TNC pick-up area, the existing Off-Airport Parking Shuttle Area would need to be relocated to the hatched area on the west side of the Arrivals Area; and also requires the relocation of current CBP parking area. In addition, Option A includes the installation of two Rapid Rectangular Flashing Beacons (RRFB) at the Terminal 2 Garage Pedestrian Crosswalk.

Based on observations, the number of TNC vehicles attempting to utilize the passenger/TNC parking spaces is higher than the existing number of parking spaces provided in the area. The proposed new TNC pick-up area would allow for additional parking capacity in the Arrivals Area, tripling the number of available spaces (5 current vs. 15 proposed). Furthermore, Option A recommends installation of two Rapid Rectangular Flashing Beacons (RRFB) at the Terminal 2 Garage Pedestrian Crosswalk. It was observed that vehicles in the outside lanes in the Arrivals Area cause visibility concerns for pedestrians crossing the outside lanes to and from Terminal 2 Garage. To provide enhanced notice and visibility, and to improve pedestrian safety, Rapid

Rectangular Flashing Beacons (RRFB) are recommended. It is expected that Option A would eliminate sustained queuing and backups to Lambert International Boulevard originating in the arrivals area; and would significantly minimize sporadic congestion.

The following is a summary of advantages and considerations for Option A:

- Provides additional dedicated pick-up area for TNCs by utilizing vacant space.
- Triples the available stacking space for passenger vehicles/TNC pick-up vehicles.
- Expected to eliminate sustained queuing and significantly minimize sporadic queuing in the Arrivals Area.
- Constrained access to eastbound I-70 from Off-Airport Parking Shuttle area.
- Long-term relocation of Rental Car Shuttles to inside lanes, possibly to the new TNC pick-up area, is feasible. This would provide separate areas for passenger vehicles and commercial vehicles and is expected to enhance traffic flow.
- Impacts international pick-ups outside Entrance 16.

Table 2 summarizes the preliminary cost estimate for the proposed improvements included in Option A.

Table 2: Option A Cost Estimate

New TNC pick-up area east of terminal building	$265,000
Off-airport shuttle pick-up area west of terminal	$100,000
Pedestrian Crosswalk RRFBx2	$35,000
Engineering, Administration, and Contingencies	$100,000
Option A Total Cost Estimate	**$500,000**

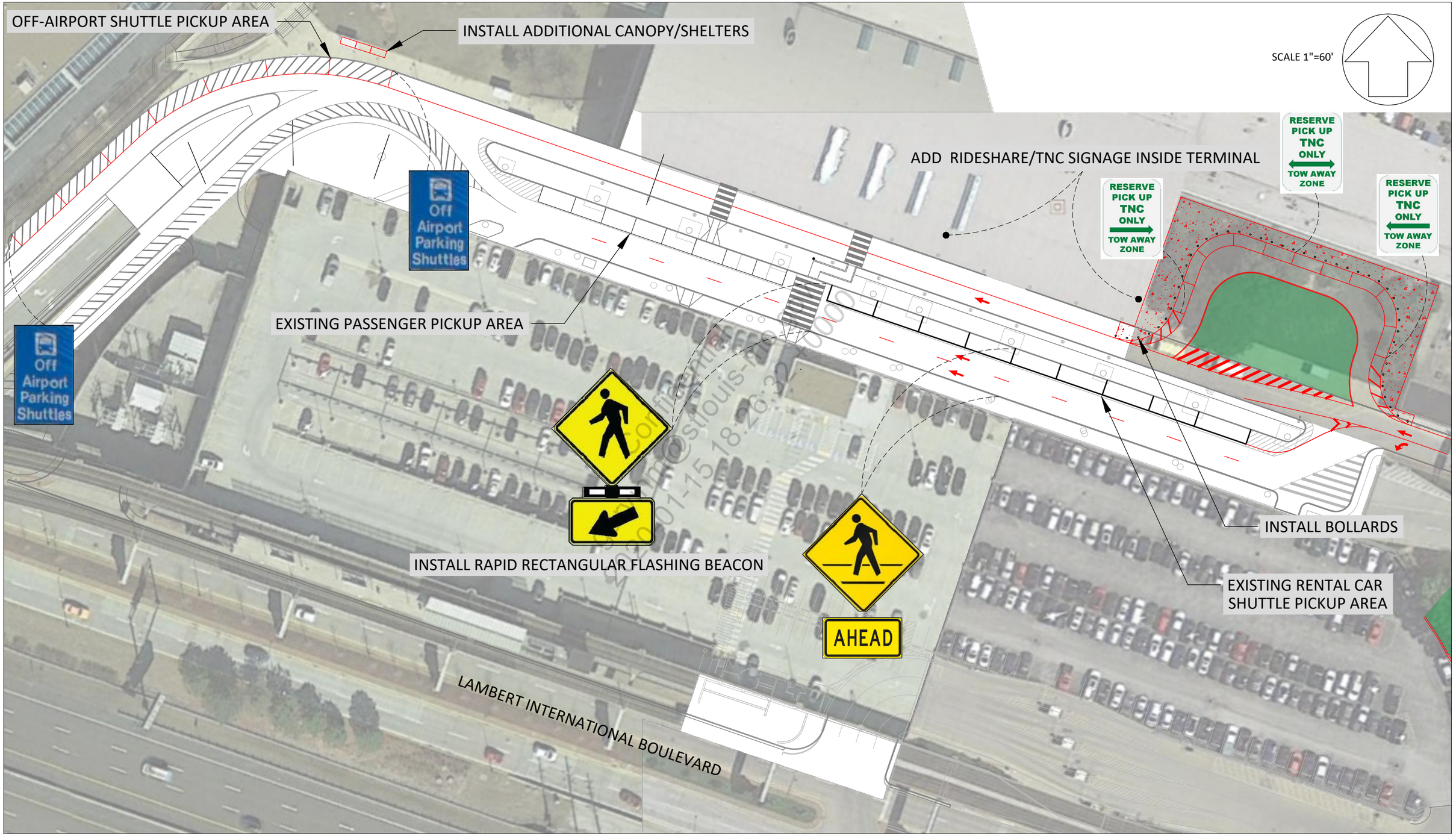

Exhibit A: Option A - Provide TNC Pickup Area at East-side Terminal Area and Relocate Off-Airport Shuttle Pickup Area

Option B - New DMS Board includes the addition of a Dynamic Message Sign (DMS) near the Air Flight Drive/Lambert International Boulevard interchange. The proposed sign would provide information on Terminal 2 Garage and Parking Lot E availability before vehicles reach Terminal 2. It was observed that vehicles are turned away at the Terminal 2 Garage if the parking facility is already full. Currently installed DMS signs on Lambert International Boulevard do not provide advance parking availability information for vehicles coming off westbound I-70 and Air Flight Drive. Providing a DMS before vehicles arrive at Terminal 2 allows for vehicles to find another location to park if the Terminal 2 Garage or Parking Lot E are full. **Exhibit B** illustrates the proposed location of the DMS. The preliminary cost estimate for Option B is $125,000.

Exhibit B: Option B - Install New Dynamic Message Sign (DMS)

Option C - Departures Area Modifications is recommended to provide short-term congestion relief for the Departures Area by providing eight (8) additional angled-parking spaces for drop-off vehicles, which will increase the total amount of angled-parking spaces to twenty-one (21). **Exhibit C** illustrates the conceptual design of the proposed Option C. The additional parking spaces would come from insignificant modifications to the existing pedestrian median and restriping the parking spaces with no buffers in between the spaces. It was observed that several vehicles dropping off passengers attempted to drop-off only at the east end angled-parking spaces. Several angled-parking spaces were observed to be double stacked; and the resulting queue from the parking spaces creates blockage of both outside lanes. In addition to physical modifications, Option C recommends providing two additional active traffic control personnel to better manage passenger drop-off operations. The active traffic control personnel should be adequately trained to direct vehicles to drive forward to exit the angled-spaces and to ensure utilization of all available parking spaces, including the spaces at the west end of the terminal. Full use of all available parking spaces vehicles would prevent blockage of the outside lanes. It is expected that Option C would eliminate sustained queuing and significantly minimize sporadic queuing in the departures area. The preliminary cost estimate for Option C is $100,000.

The following is a summary of advantages and considerations for Option C:

- Provides additional parking spaces by restriping current parking area.
- Adds 8 parking spaces in the departures area.
- Expected to eliminate sustained queuing and significantly minimize sporadic queuing.
- Requires modification to current curbside Bag-drop Area to allow for moving the concrete barriers away from the travel lanes.
- Requires two additional traffic control personnel to better manage traffic flow and drop-off parking.

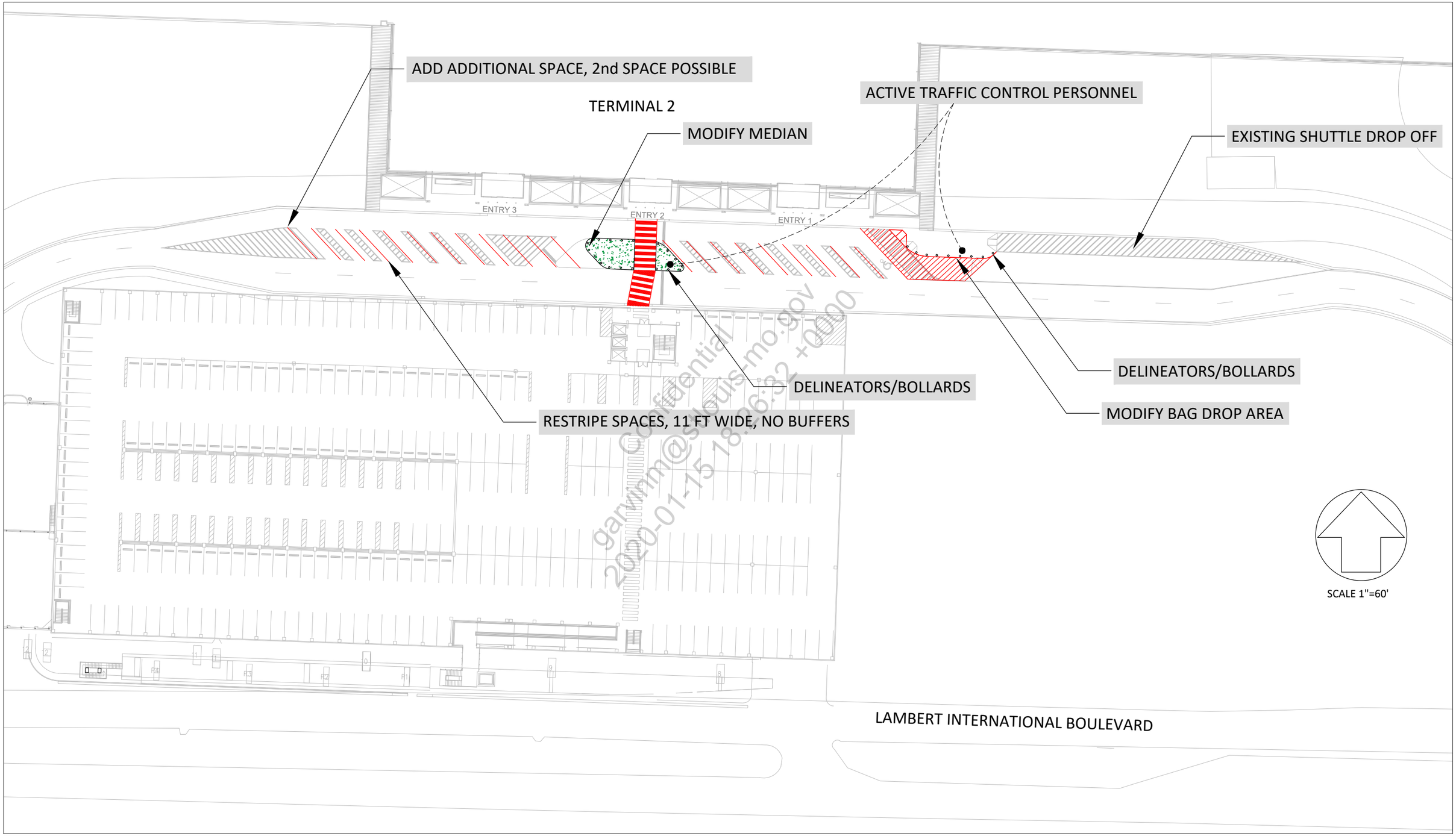

Exhibit C: Option C - Modified Drop-off Departures Area

Long-Term Recommendations

Option D - Intersection Enhancements includes:

- intersection improvements at Lambert International Boulevard and Terminal 2 Drive signalized intersection
- intersection modifications and new restrictions at Terminal 2 Drive and Air Cargo Road intersection
- reconfiguration of Arrivals Area Entrance lane to provide two entering lanes north of Air Cargo Road signalized intersection
- two additional entrances to Terminal 2 Garage Entrance

Exhibit D shows the conceptual layout for the proposed Option D. It is recommended that Option D should only be implemented after the implementation of Option A. Currently, the left outside lane of the Arrivals Area provides access to the Terminal 2 Garage. The location of the entrance is inconvenient because vehicles must go through nearly the entire Arrivals Area to reach the garage entrance. It was observed that vehicles are turned away at the garage entrance if the parking garage is already full. Relocating the parking garage entrance outside of the Arrivals Area would allow for the left outside lane to be utilized as an additional drive lane.

An additional Terminal 2 Garage entrance is proposed to be located on Lambert International Boulevard east of the existing Terminal 2 Garage Exit signalized intersection. However, this new entrance could only be utilized by westbound Lambert International Boulevard vehicles due to the raised median blocking entrance for eastbound Lambert International Boulevard vehicles. As such, a second additional garage entrance for the eastbound traffic is proposed across from Air Cargo and Terminal 2 Drive intersection. The two proposed garage entrances could be constructed independent of each other.

To provide the new garage entrance at Air Cargo Road and Terminal 2 Drive intersection, and to improve utilization at the signalized intersection, additional roadway improvements and restrictions are required at the Air Cargo Road and Terminal 2 Drive intersection and at Lambert International Boulevard and Terminal 2 Drive intersection. Specifically, the southbound Air Cargo approach at Terminal 2 Drive signalized intersection would need to be restricted to prohibit left-turns onto Lambert International Boulevard. Based on traffic count data, the number of vehicles making this movement is minimal and vehicles could reasonably access Lambert International Boulevard via Arrivals Area or Departures Area Entrance lanes. Additionally, Option D includes providing a triple left-turn lane from Lambert International Boulevard onto Terminal 2 Drive.

To evaluate the recommended modifications' impact on intersection operations, turning movement count data available from November of 2017 was utilized. Based on the traffic data collected, the existing morning peak hour occurred between 8:00 a.m. and 9:00 a.m., the existing midday peak hour occurred between 12:00 p.m. and 1:00 p.m., and the existing evening peak hour occurred between 4:30 p.m. and 5:30 p.m. To determine the traffic that would shift to the proposed new garage entrance, the hourly entry data for the Terminal 2 Garage was utilized.

Based on the data, it was determined that there would be an estimated 69 vehicles per hour (vph), 65 vph, and 76 vph utilizing the new entrance during the morning, midday, and evening peak hours, respectively.

Traffic operational analysis was completed using SYNCHRO version 10 macro-level analytical traffic flow modeling. SYNCHRO is based on procedures outlined in the *Highway Capacity Manual* to determine estimates of capacity and operational performance of signalized and unsignalized intersections. SYNCHRO is recognized as the most widely-used tool in the traffic engineering field for analyzing and optimizing traffic flows. Based on SYNCHRO modeling, Option D is expected to provide significant reduction in travel delays, approximately 30% compared to existing conditions; and significantly improve traffic flow at Terminal 2. In addition, the proposed intersection enhancements provide better lane utilization at both signalized intersections and along Lambert International Boulevard.

The following is a summary of advantages and considerations for Option D:

- Provides two additional T2 garage entrances and is expected to eliminate queuing in the parking lane in the Arrivals area.
- Provides better overall lane usage and signal operations.
- Prohibits left-turns out of Air Cargo Road.
- Expensive improvements option.

Table 3 summarizes the cost estimate for the proposed improvements provided in Option D.

Table 3: Option D Cost Estimate

Reconfiguration of Air Cargo Road/Terminal 2 Drive intersection	$400,000
Reconfiguration of Lambert International Boulevard/Terminal 2 Drive intersection	$500,000
Westbound Lambert International Boulevard Garage entrance	$150,000
New Garage entrance at Air Cargo Road intersection	$200,000
Engineering, Administration, and Contingencies	$250,000
Option D Total Cost Estimate **Assumes completion of Option A*	**$1,500,000**

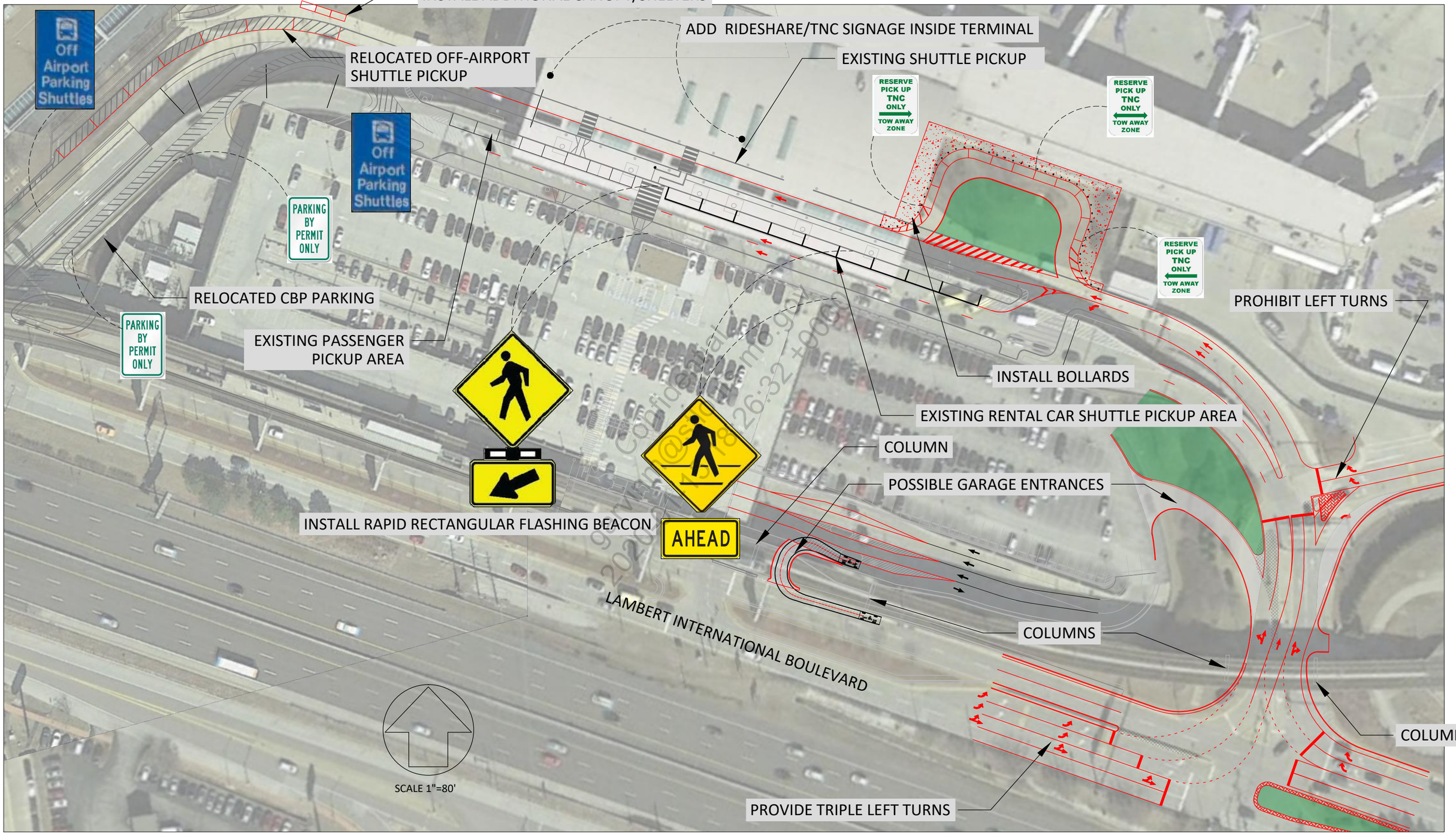

Exhibit D: Option D - Intersection Improvements, New Parking Lot Entrances

Additional Options

In addition to the above listed recommendations, the following additional options are being included here for consideration and long-term planning purposes. **Appendix B** shows conceptual layouts for these additional options.

- A modification of Option D recommended above would be to relocate Rental Car Shuttles to the new parking area east of the terminal and use the existing Rental Car Shuttle Area for TNC pick-ups. This option would benefit traffic flow by providing outside lanes usage for passenger vehicles and inside lanes usage for shuttles.

- Another modification of Option D recommended above would be to relocate Passenger Pick-up Area to an off-site location, possibly within the current Cell-Phone Lot on Air Cargo Road. This would require acquisition/operation of approximately six (6) additional vehicles to serve as Passenger Pick-up Shuttles to move passengers between Terminal 2 and Cell-Phone Lot with ten-minute headways. Under this option, there would be no passenger pick-up via passenger vehicles at the terminal. Instead, vehicles picking up arriving passengers would wait at the Cell-Phone Lot and pick-up passengers arriving via Shuttles. Passenger acceptance of this option should be evaluated, possibly via surveying, to provide comprehensive analysis. This option is expected to provide significant benefits from a traffic operations perspective.

- An alternative drop-off configuration was developed for the Departures Area to modify the current angled-parking spaces to parallel parking spaces immediately adjacent to the curb. This option is expected to provide similar operations as Option C.

- Expansion of capacity at Terminal 2 Garage should be considered a long-term priority. This could be achieved by the construction of an additional parking structure on the existing surface area of Terminal 2 Garage.

Appendix A

Data Figures and Tables

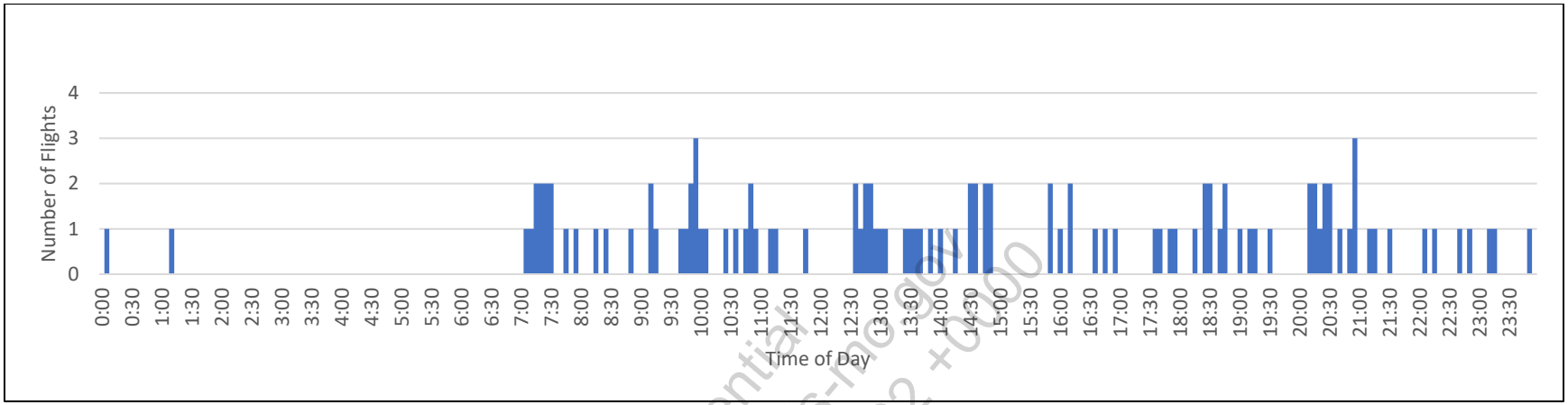

Figure A1: Arrival Flights Per 5 Minutes on Thursday, May 3, 2018

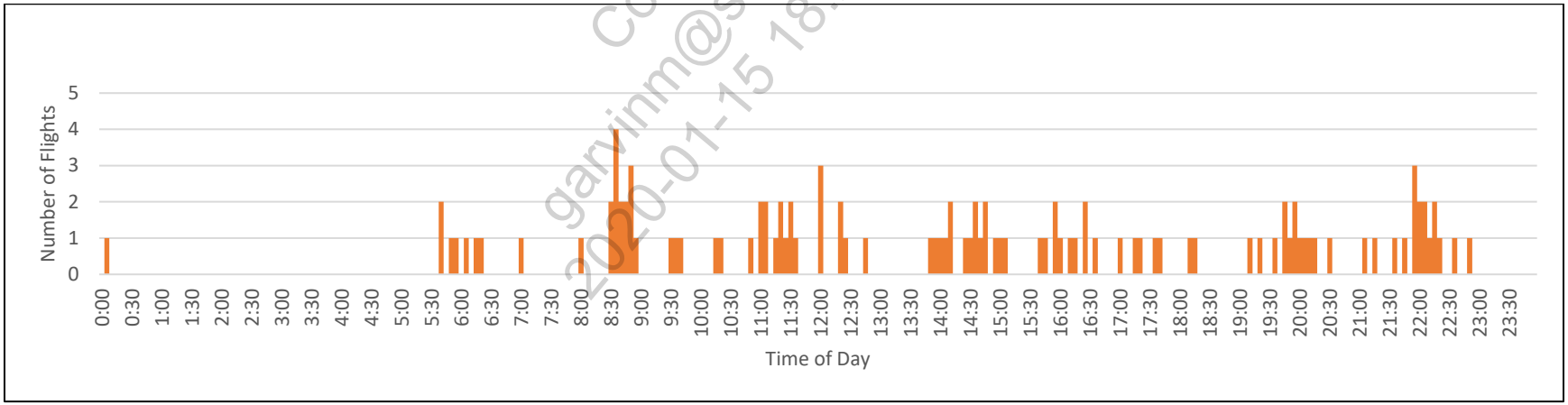

Figure A2: Departure Flights Per 5 Minutes on Thursday, May 3, 2018

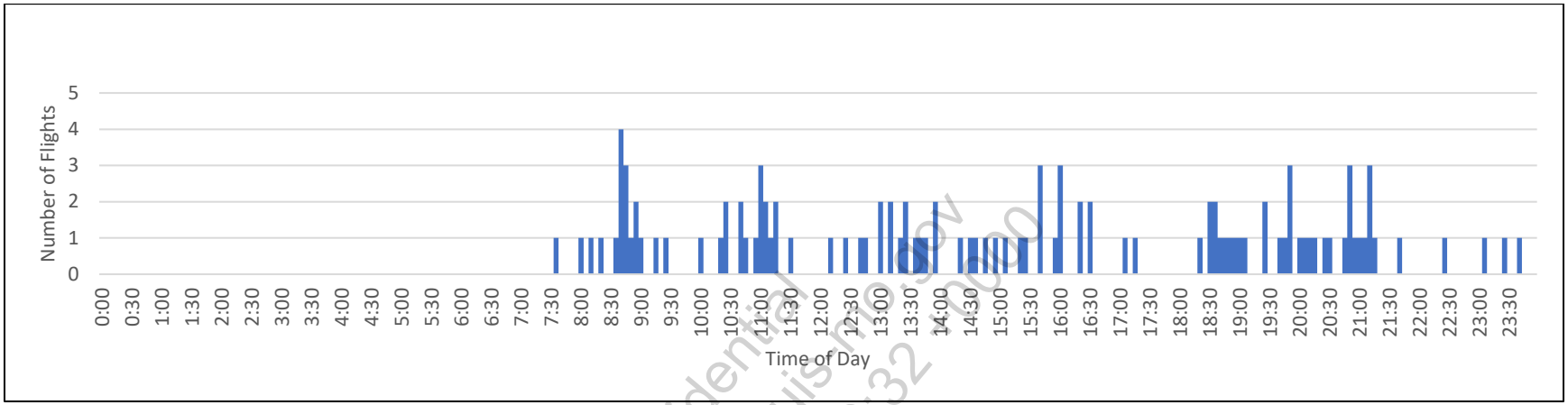

Figure A3: Arrival Flights Per 5 Minutes on Sunday, May 6, 2018

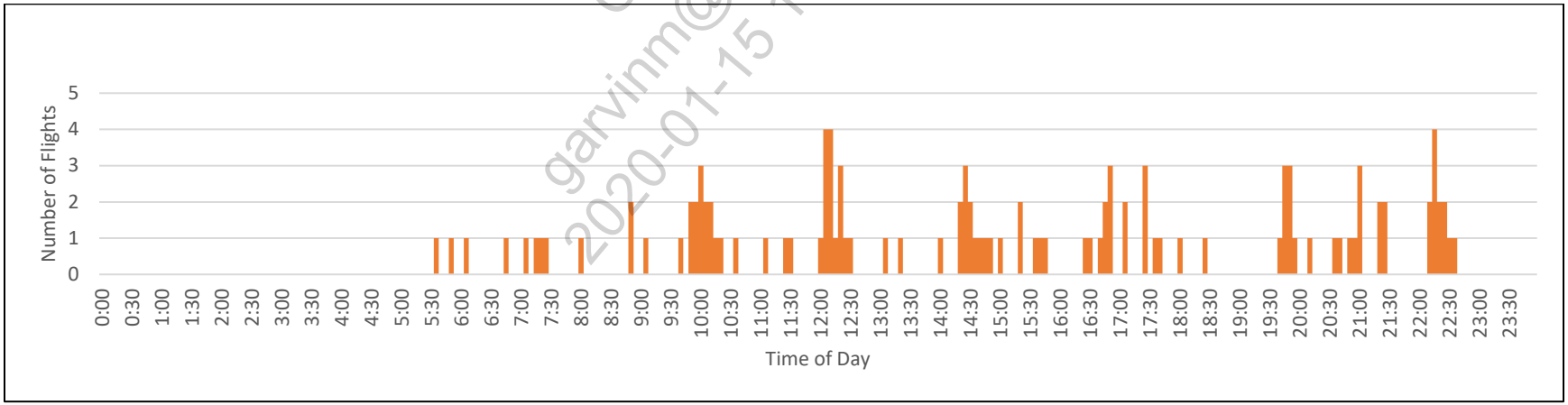

Figure A4: Departure Flights Per 5 Minutes on Sunday, May 6, 2018

Figure A5: Estimated Number of Passengers Arriving and Departing Per Day*

*Estimated based on number of flights and flight capacity

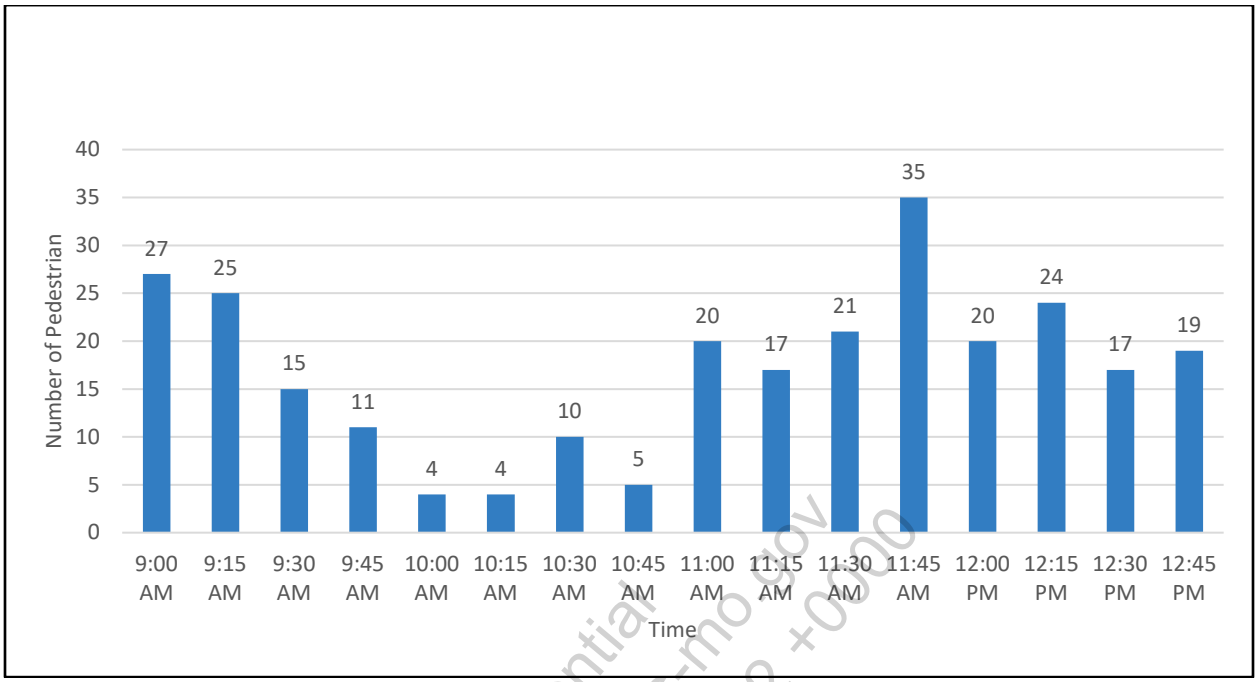

Figure A6: Departures Area – Number of Northbound Pedestrians at Terminal 2 Garage Pedestrian Crosswalk

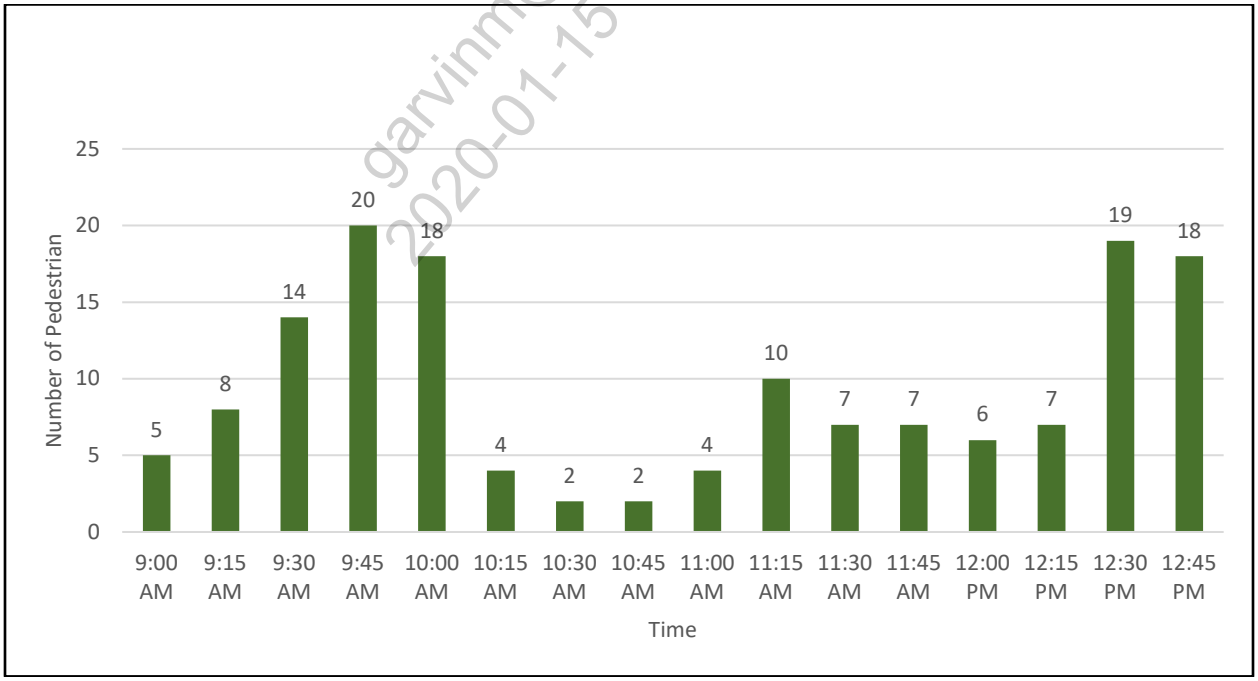

Figure A7: Departures Area – Number of Southbound Pedestrians at Terminal 2 Garage Pedestrian Crosswalk

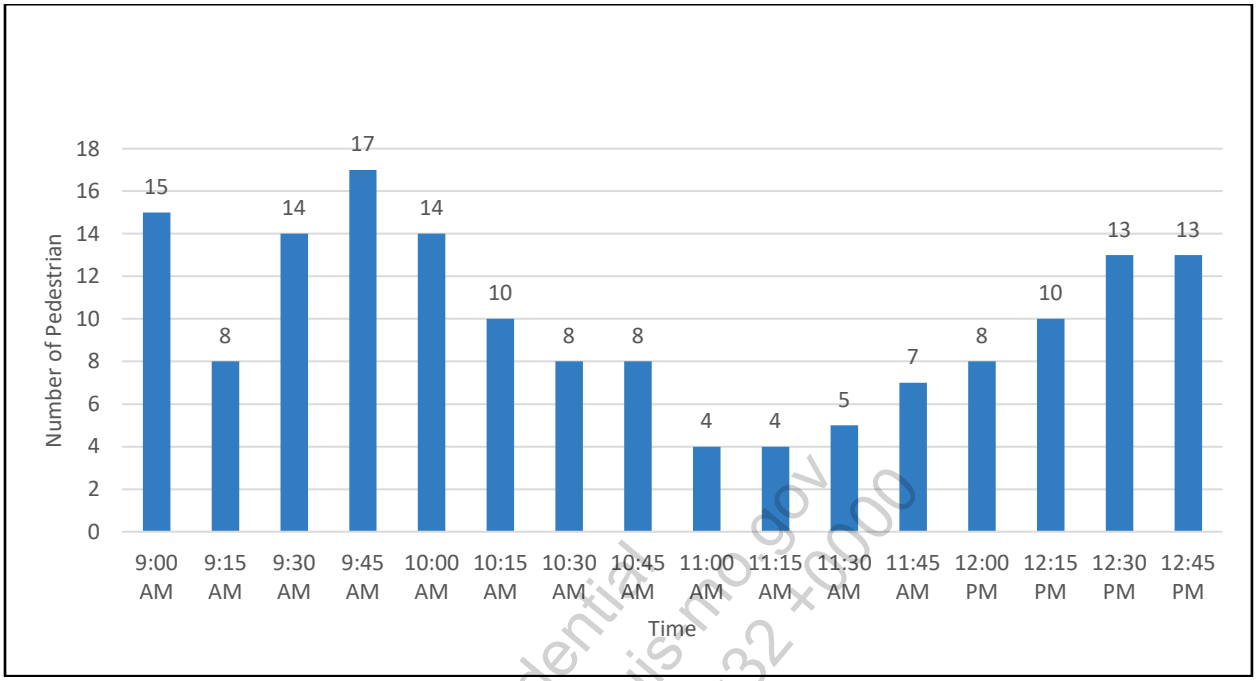

Figure A8: Arrivals Area – Number of Northbound Pedestrians at Terminal 2 Garage Pedestrian Crosswalk

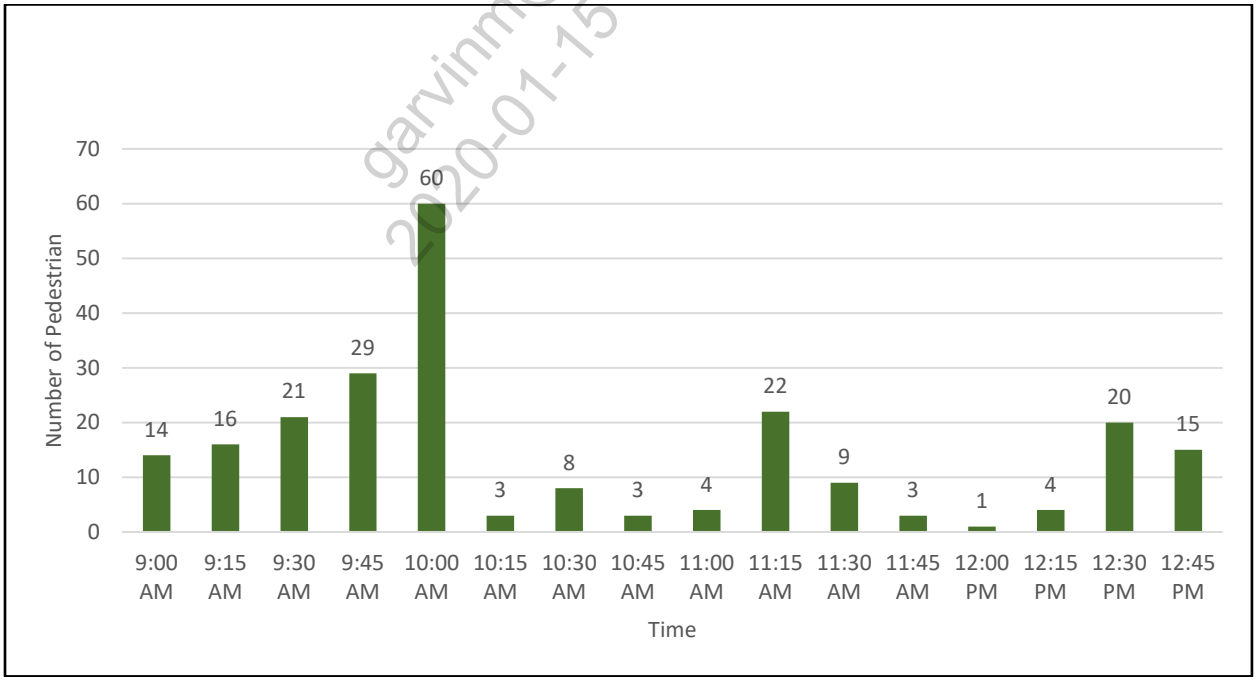

Figure A9: Arrivals Area – Number of Southbound Pedestrians at Terminal 2 Garage Pedestrian Crosswalk

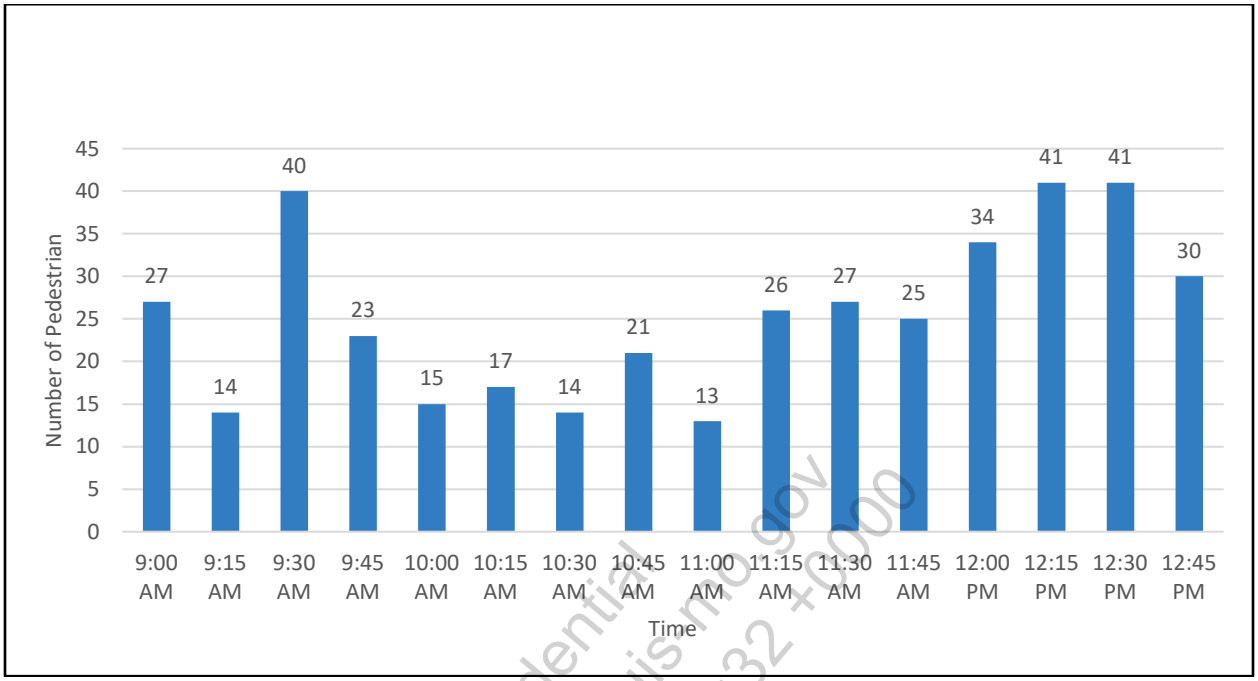

Figure A10: Arrivals Area – Number of Northbound Pedestrians at East Parking Shuttle Pedestrian Crosswalk

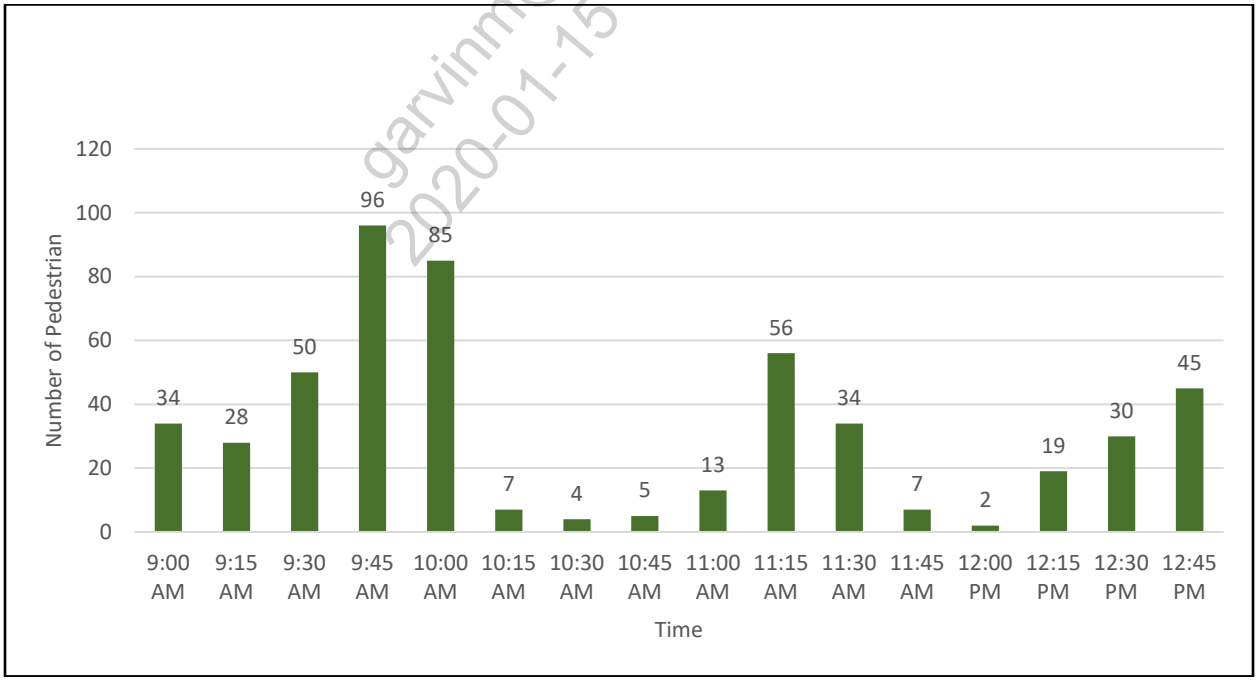

Figure A11: Arrivals Area – Number of Southbound Pedestrians at East Parking Shuttle Pedestrian Crosswalk

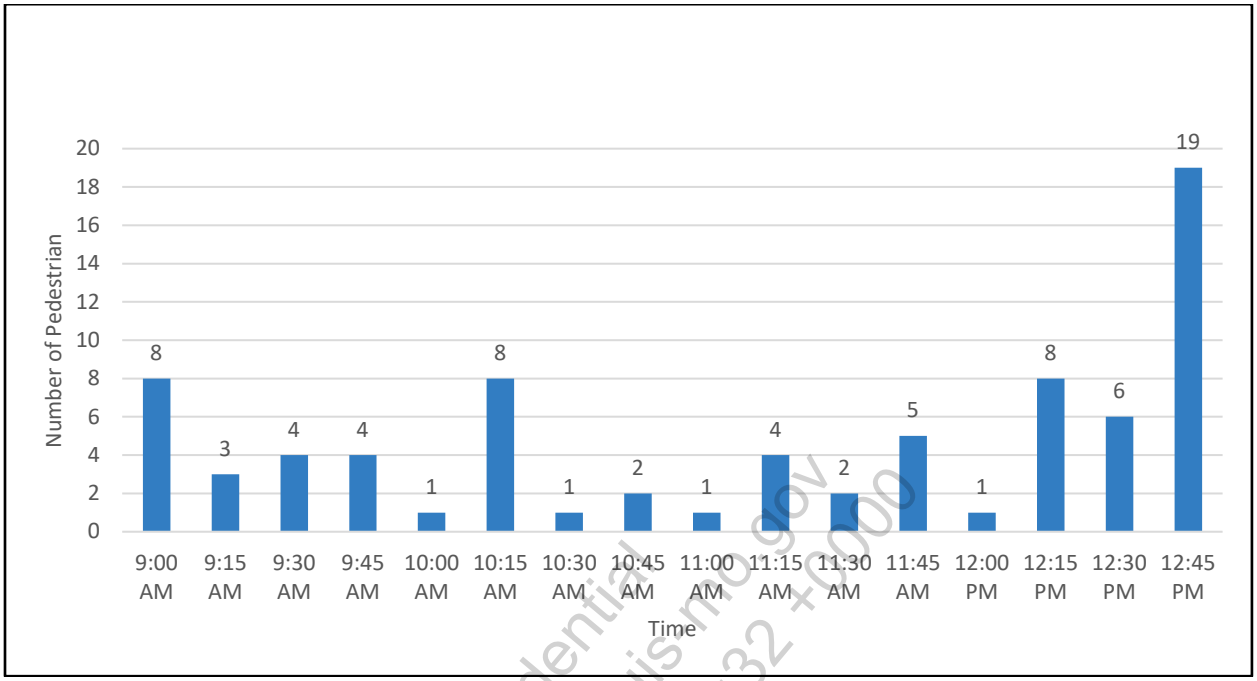

Figure A12: Arrivals Area – Number of Northbound Pedestrians at West Parking Shuttle Pedestrian Crosswalk

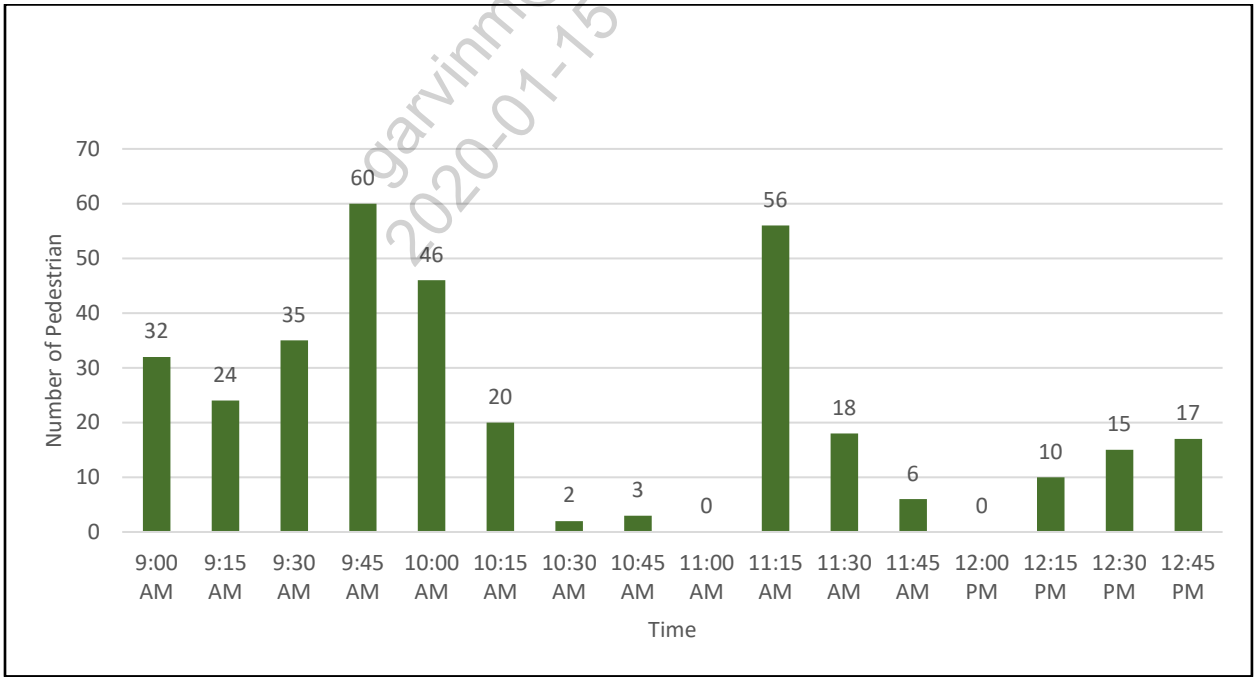

Figure A13: Arrivals Area – Number of Southbound Pedestrians at West Parking Shuttle Pedestrian Crosswalk

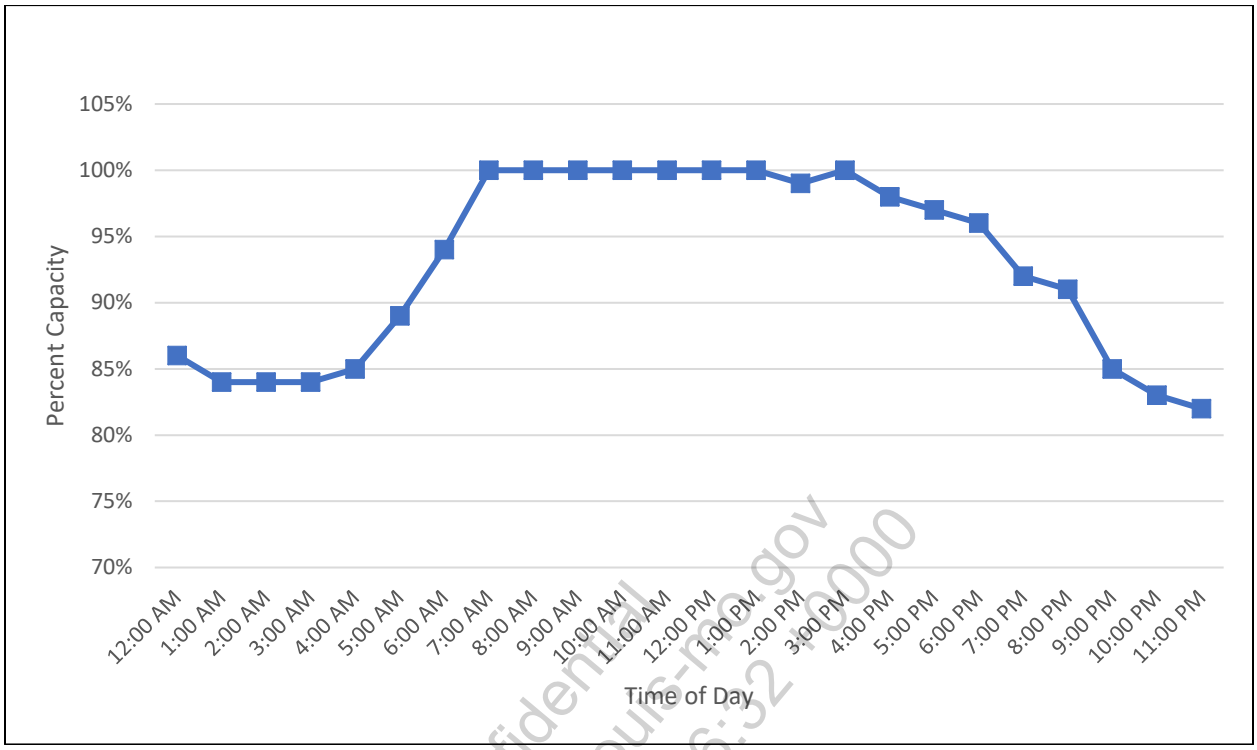

Figure A14: Terminal 2 Garage Occupancy on Tuesday, May 1, 2018

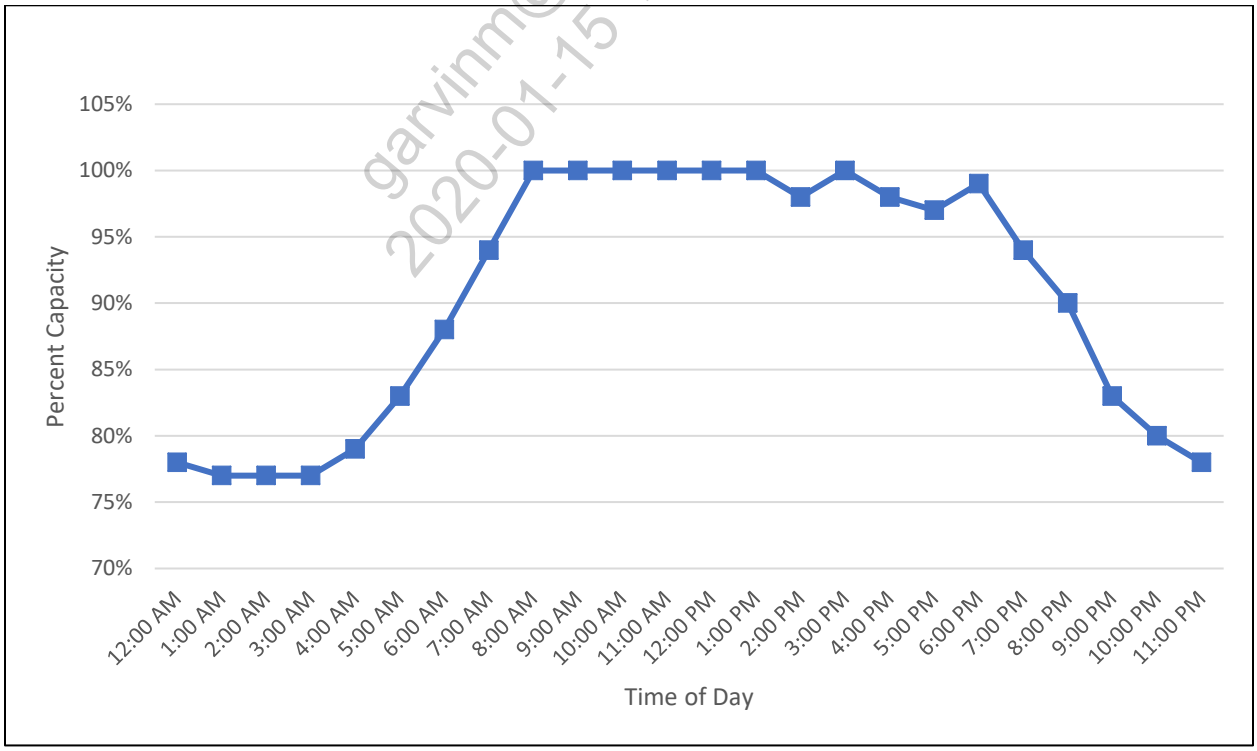

Figure A15: Terminal 2 Garage Occupancy on Wednesday, May 2, 2018

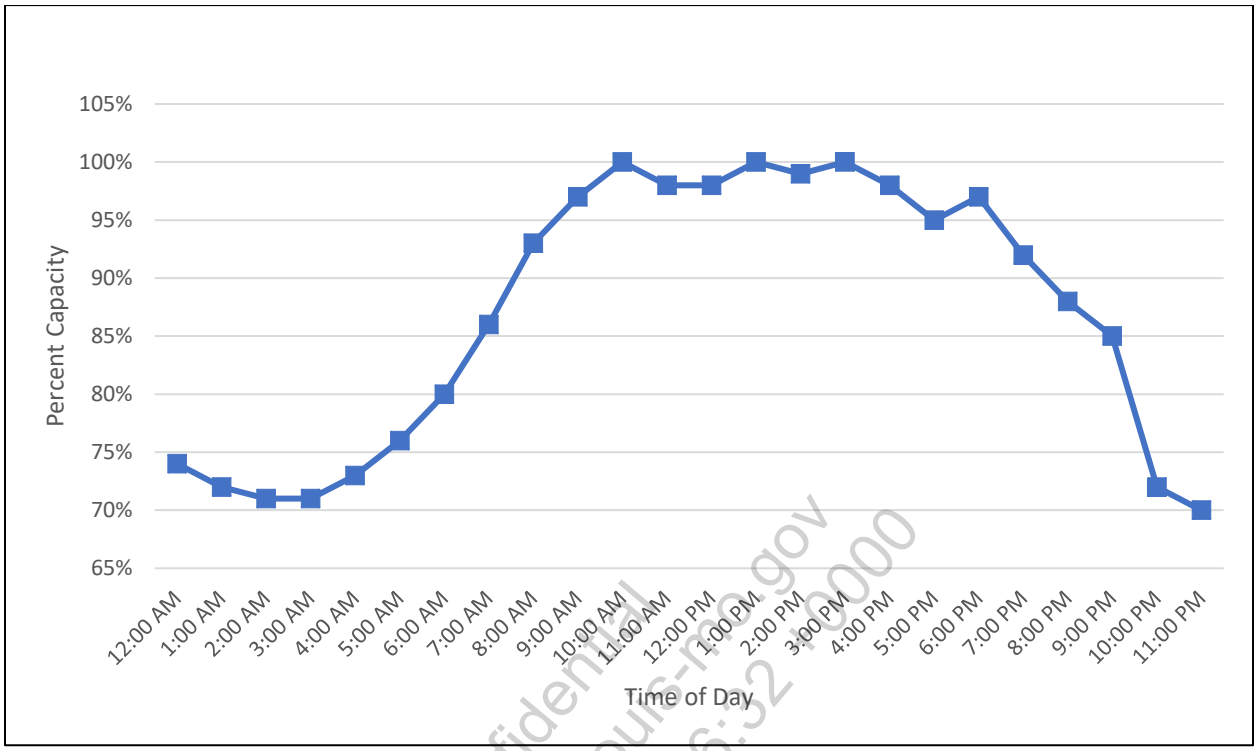

Figure A16: Terminal 2 Garage Occupancy on Thursday, May 3, 2018

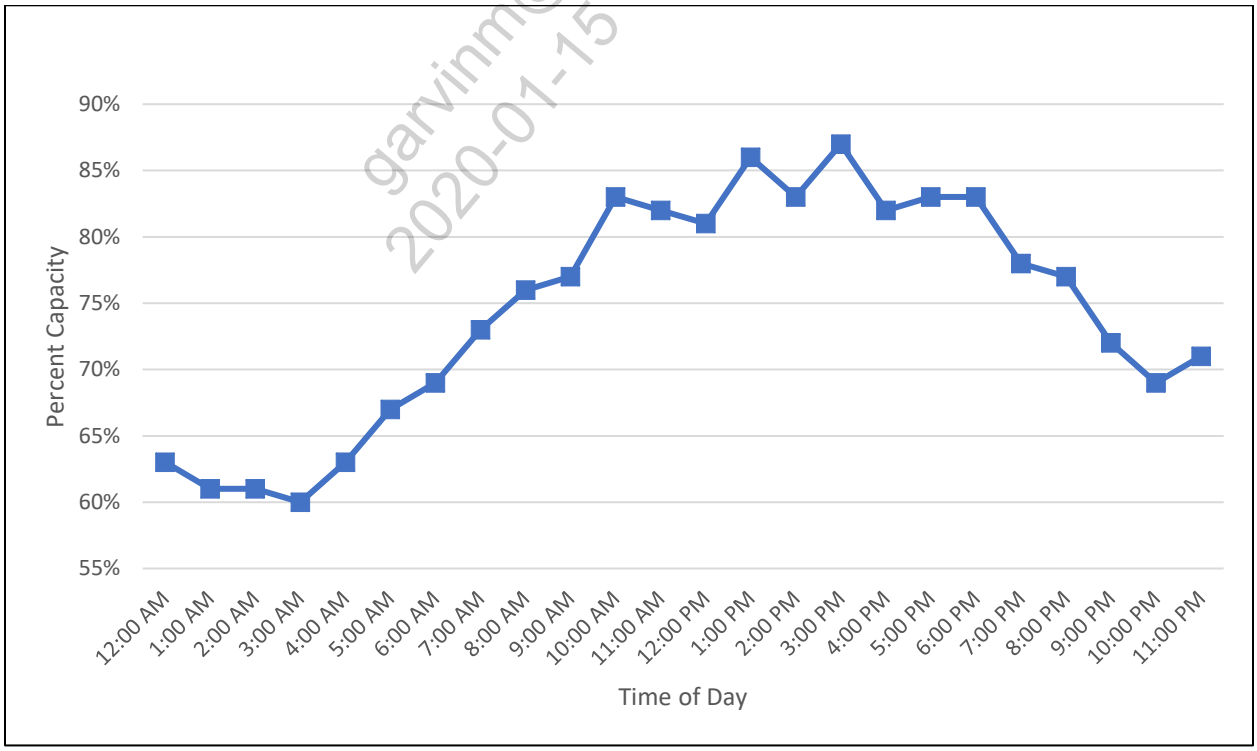

Figure A17: Terminal 2 Garage Occupancy on Friday, May 4, 2018

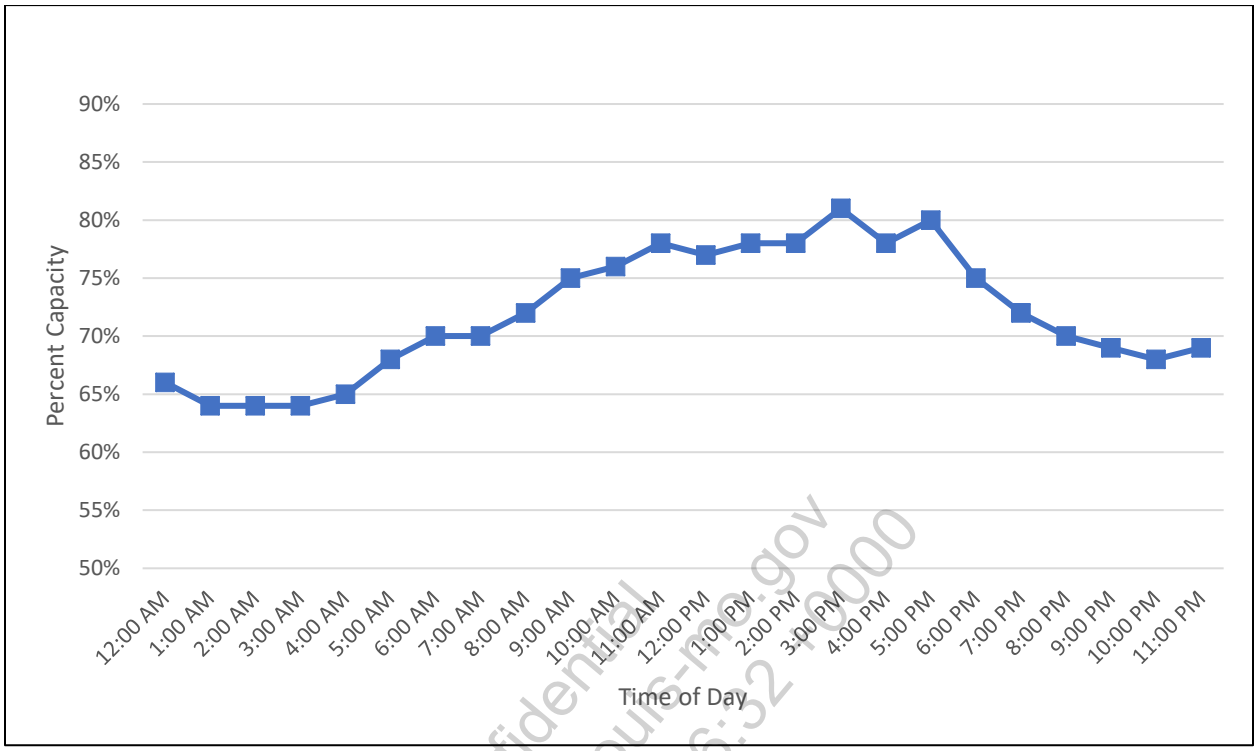

Figure A18: Terminal 2 Garage Occupancy on Saturday, May 5, 2018

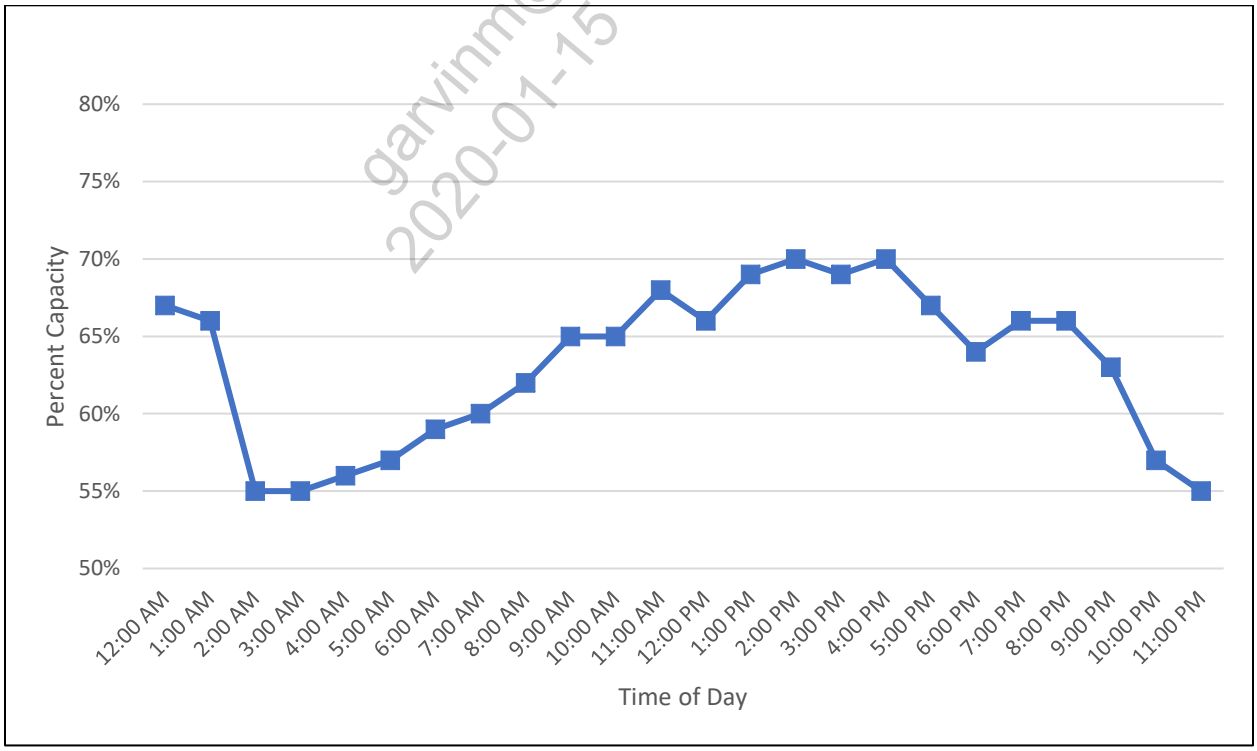

Figure A19: Terminal 2 Garage Occupancy on Sunday, May 6, 2018

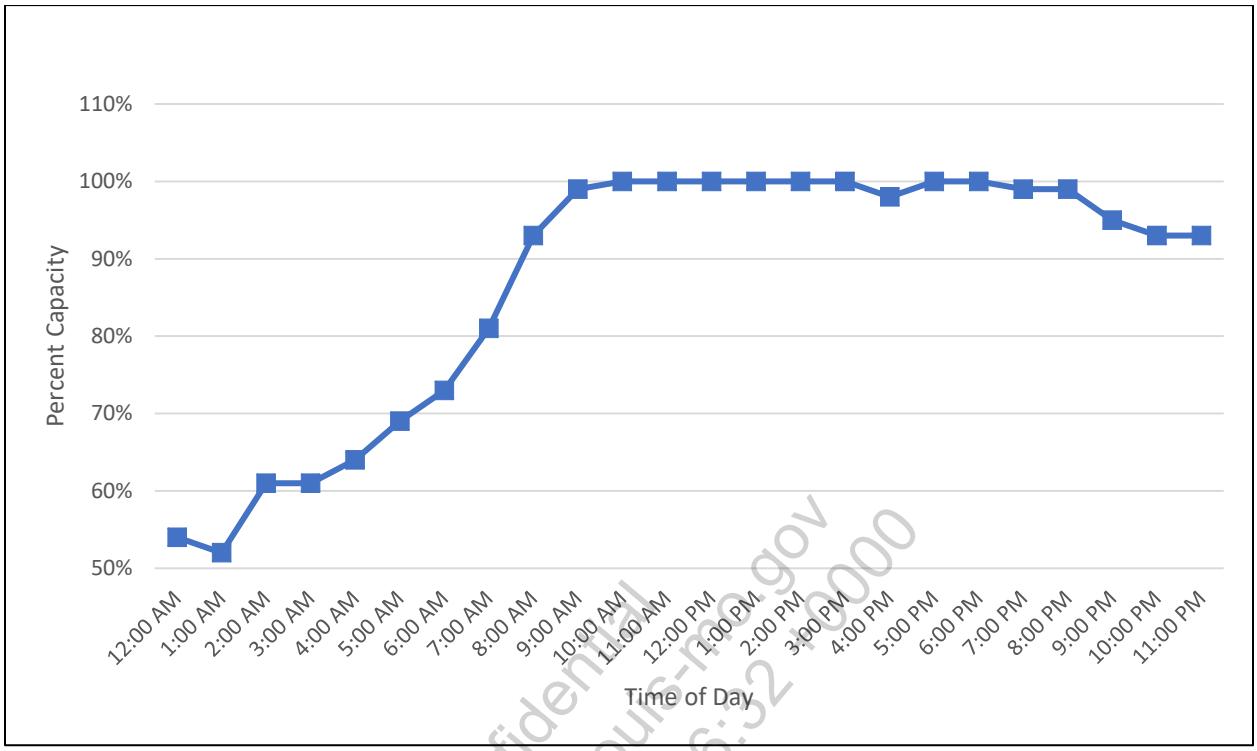

Figure A20: Terminal 2 Garage Occupancy on Monday, May 7, 2018

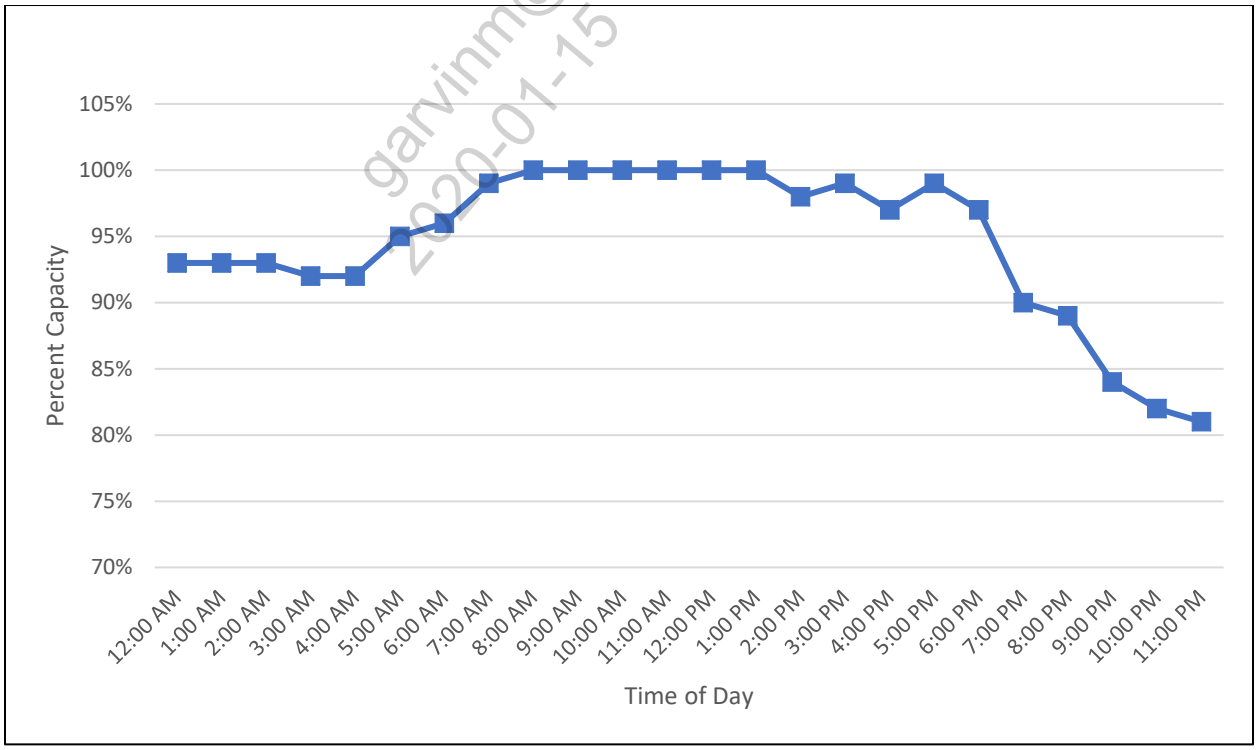

Figure A21: Parking Lot E Garage Occupancy on Tuesday, May 1, 2018

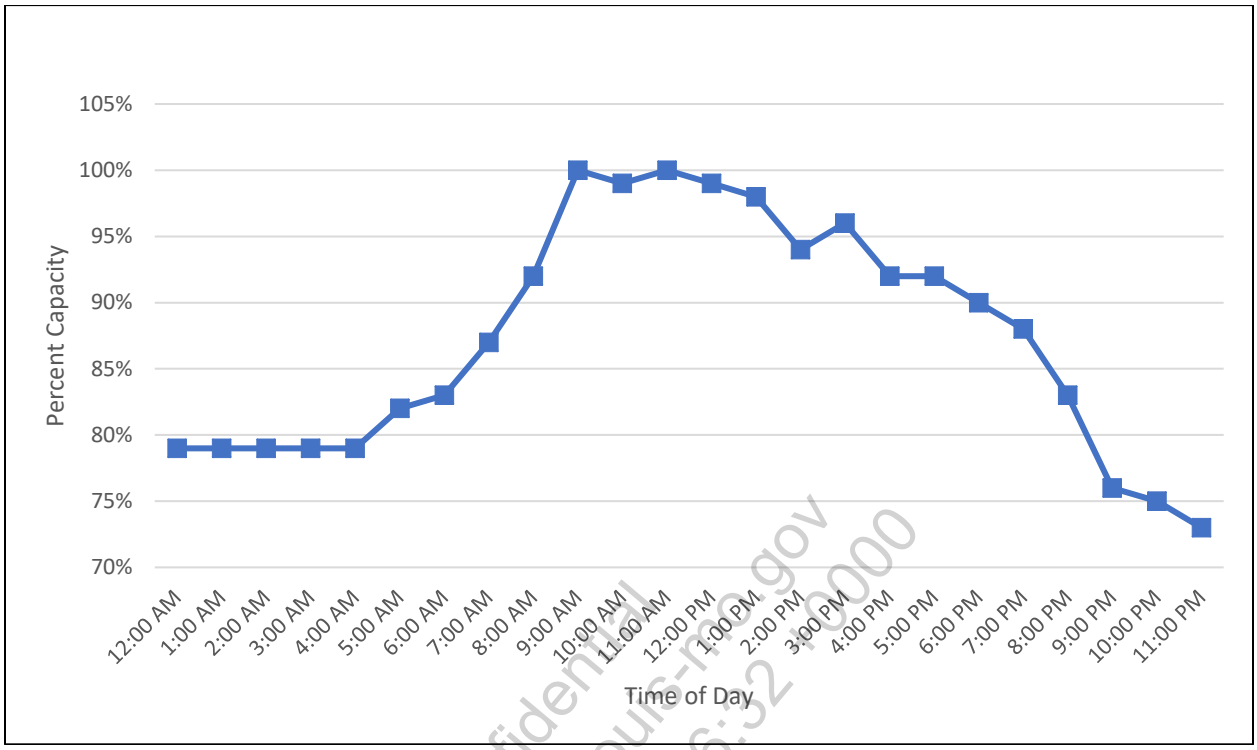

Figure A22: Parking Lot E Garage Occupancy on Wednesday, May 2, 2018

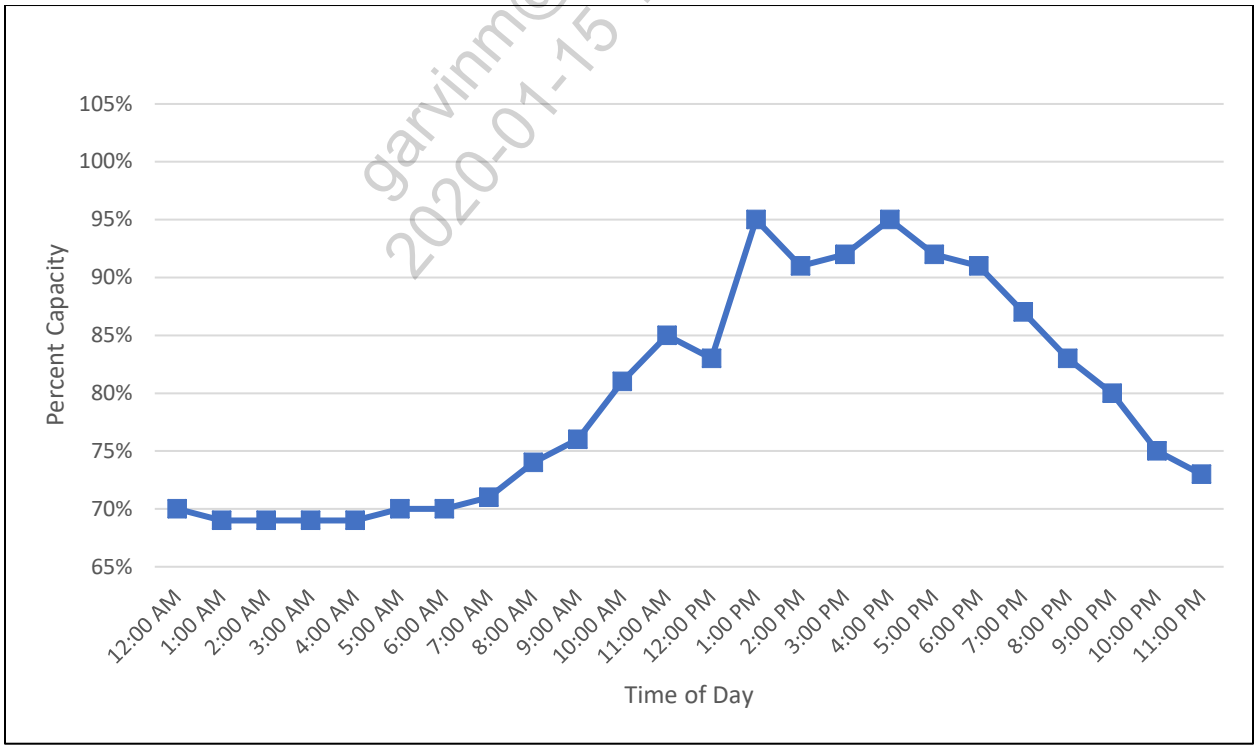

Figure A23: Parking Lot E Garage Occupancy on Thursday, May 3, 2018

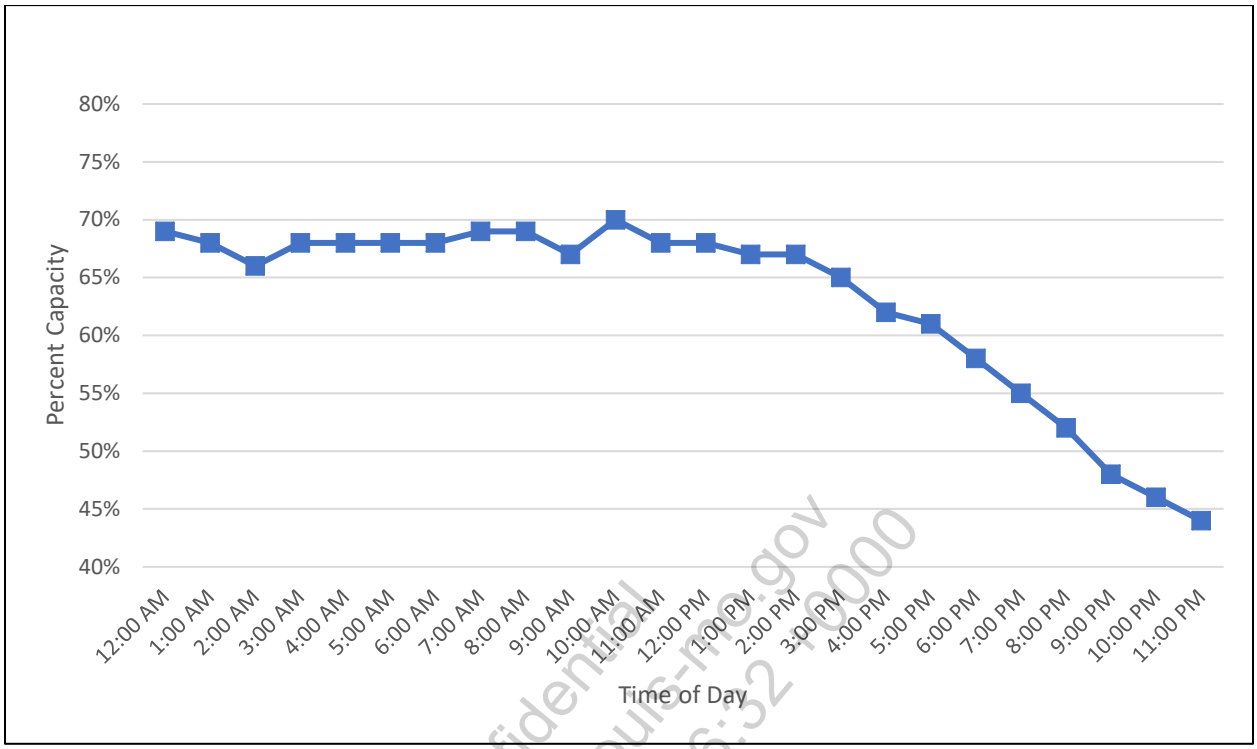

Figure A24: Parking Lot E Garage Occupancy on Friday, May 4, 2018

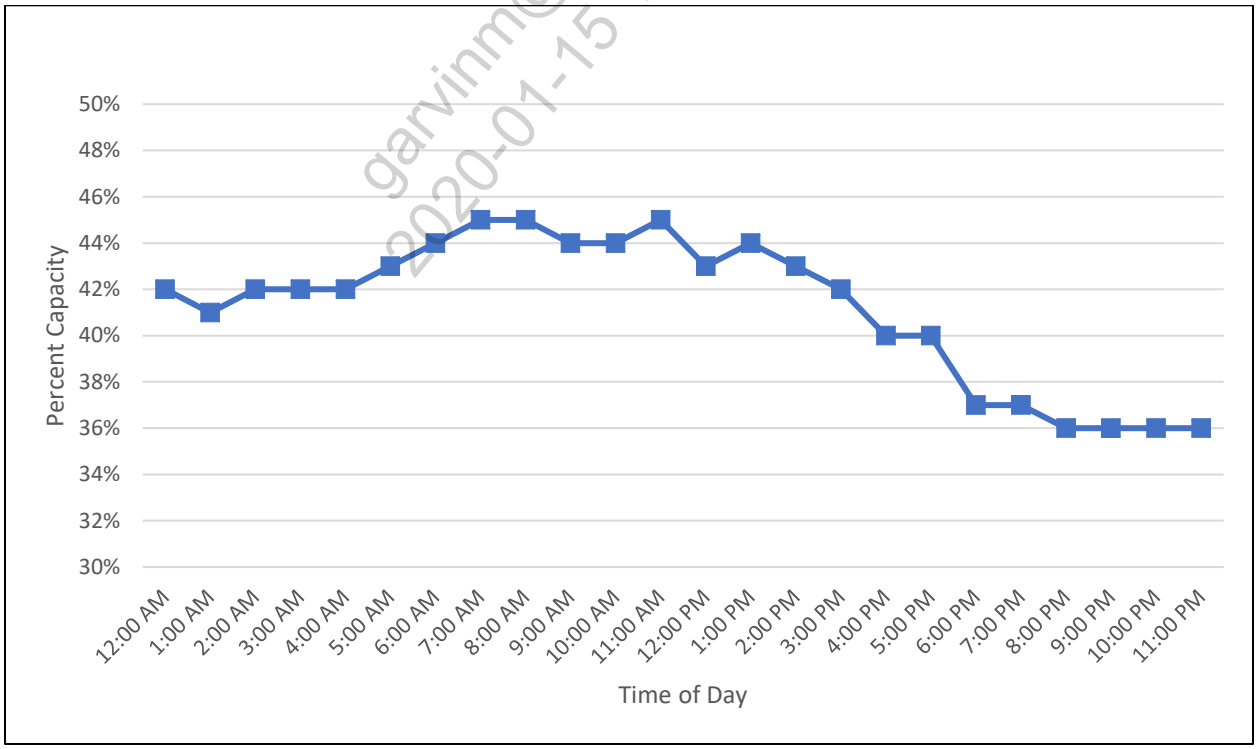

Figure A25: Parking Lot E Garage Occupancy on Saturday, May 5, 2018

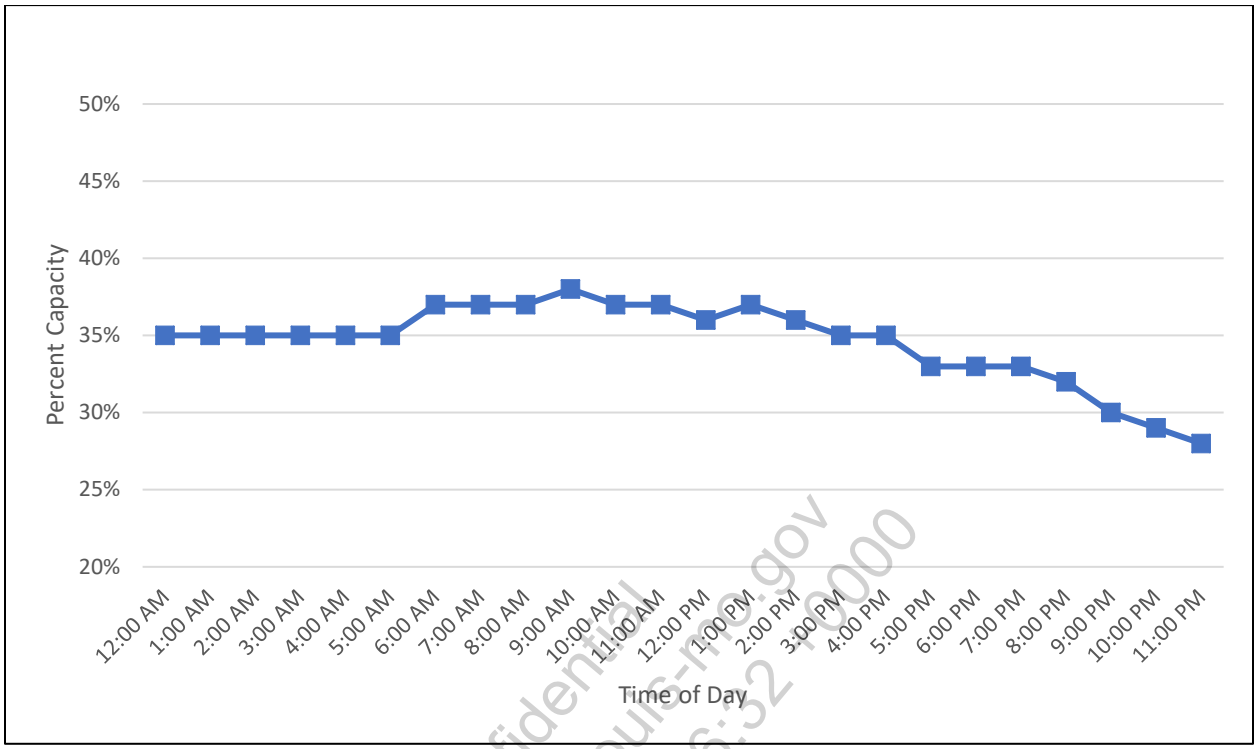

Figure A26: Parking Lot E Garage Occupancy on Sunday, May 6, 2018

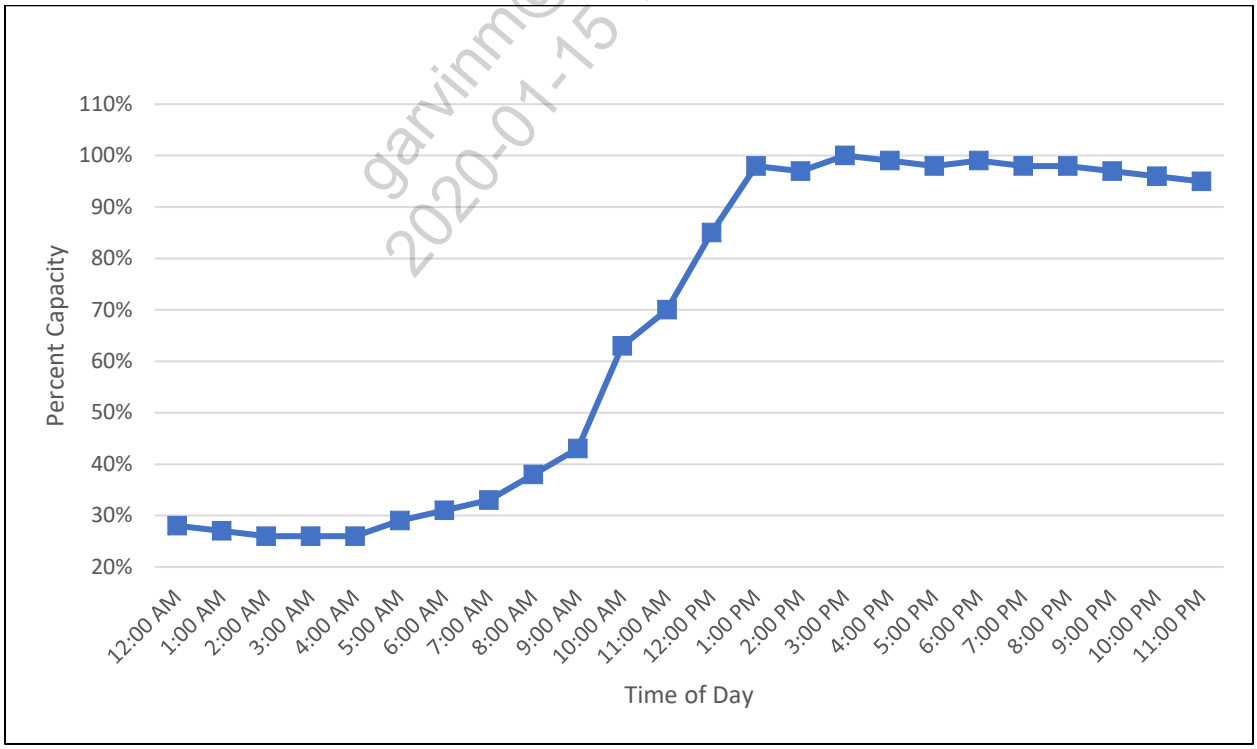

Figure A27: Parking Lot E Garage Occupancy on Monday, May 7, 2018

Table A28: Existing and Proposed Geometrics Operating Conditions

Intersection/Approach	AM Peak Hour		Midday Peak Hour		PM Peak Hour	
	Existing Geometrics	Proposed Geometrics	Existing Geometrics	Proposed Geometrics	Existing Geometrics	Proposed Geometrics
Lambert International Blvd and Air Cargo Road – Signalized						
Eastbound Lambert International Boulevard	C (25.5)	B (16.7)	C (25.2)	B (16.3)	C (25.4)	B (16.3)
Westbound Lambert International Boulevard	A (6.3)	A (3.4)	A (6.7)	A (3.5)	A (8.9)	A (5.1)
Southbound Air Cargo Road	E (61.0)	--	E (56.8)	--	E (56.1)	--
Overall Intersection	**B (20.0)**	**B (11.9)**	**C (20.2)**	**B (12.0)**	**B (18.8)**	**B (10.6)**
Air Cargo Road and Departure/Arrival Entrances – Signalized						
Westbound Air Cargo Road	C (27.4)	A (1.1)	C (24.0)	A (2.3)	C (33.1)	A (0.5)
Northbound Air Cargo Road	A (3.5)	A (1.9)	A (3.9)	A (2.0)	A (3.1)	A (1.4)
Overall Intersection	**A (6.7)**	**A (1.8)**	**A (7.2)**	**A (2.0)**	**A (8.8)**	**A (1.2)**

X (XX.X) - Level of Service (Vehicular delay in seconds per vehicle)

Table A29: Traffic Count Data

Leg	Terminal 2 Drive				Lambert International Blvd				Lambert International Blvd				
Direction	Southbound				Northwestbound				Southeastbound				
Start Time	Bear left	Hard right	U-Turn	**App Total**	Thru	Bear right	U-Turn	**App Total**	Hard left	Thru	U-Turn	**App Total**	**Int Total**
2017-11-09 06:00:00	1	5	0	**6**	62	46	0	**108**	71	62	0	**133**	**247**
2017-11-09 06:15:00	0	4	0	**4**	69	35	0	**104**	91	58	0	**149**	**257**
2017-11-09 06:30:00	0	3	0	**3**	48	60	0	**108**	97	76	1	**174**	**285**
2017-11-09 06:45:00	1	4	0	**5**	48	76	0	**124**	110	59	0	**169**	**298**
2017-11-09 07:00:00	1	4	0	**5**	48	76	0	**124**	131	90	1	**222**	**351**
2017-11-09 07:15:00	0	3	0	**3**	54	81	0	**135**	126	73	0	**199**	**337**
2017-11-09 07:30:00	0	5	0	**5**	51	61	0	**112**	134	71	0	**205**	**322**
2017-11-09 07:45:00	0	8	0	**8**	52	59	0	**111**	127	71	0	**198**	**317**
2017-11-09 08:00:00	0	14	0	**14**	48	57	1	**106**	112	72	1	**185**	**305**
2017-11-09 08:15:00	0	13	0	**13**	49	64	0	**113**	143	74	0	**217**	**343**
2017-11-09 08:30:00	1	5	0	**6**	50	60	0	**110**	147	70	0	**217**	**333**
2017-11-09 08:45:00	2	8	0	**10**	67	63	0	**130**	138	68	1	**207**	**347**
2017-11-09 09:00:00	0	20	0	**20**	58	96	1	**155**	172	95	0	**267**	**442**
2017-11-09 09:15:00	1	27	0	**28**	69	72	0	**141**	171	122	1	**294**	**463**
2017-11-09 09:30:00	4	10	0	**14**	41	55	0	**96**	120	126	0	**246**	**356**
2017-11-09 09:45:00	3	6	0	**9**	47	49	0	**96**	74	99	1	**174**	**279**
2017-11-09 10:00:00	0	12	0	**12**	71	33	0	**104**	139	75	1	**215**	**331**
2017-11-09 10:15:00	1	21	0	**22**	34	42	1	**77**	85	69	0	**154**	**253**
2017-11-09 10:30:00	2	16	0	**18**	50	37	0	**87**	83	65	2	**150**	**255**
2017-11-09 10:45:00	1	17	0	**18**	47	35	0	**82**	88	70	2	**160**	**260**
2017-11-09 11:00:00	1	17	0	**18**	48	36	0	**84**	91	57	2	**150**	**252**
2017-11-09 11:15:00	1	21	0	**22**	54	44	0	**98**	121	80	0	**201**	**321**
2017-11-09 11:30:00	0	10	0	**10**	59	56	0	**115**	120	106	0	**226**	**351**
2017-11-09 11:45:00	0	7	0	**7**	51	57	0	**108**	126	73	0	**199**	**314**
2017-11-09 12:00:00	0	15	0	**15**	54	76	0	**130**	124	68	0	**192**	**337**
2017-11-09 12:15:00	0	12	0	**12**	44	69	2	**115**	153	75	0	**228**	**355**
2017-11-09 12:30:00	3	13	0	**16**	42	80	0	**122**	176	93	0	**269**	**407**
2017-11-09 12:45:00	2	6	0	**8**	62	59	0	**121**	156	102	1	**259**	**388**
2017-11-09 13:00:00	0	14	0	**14**	61	76	0	**137**	108	136	0	**244**	**395**
2017-11-09 13:15:00	1	14	0	**15**	50	74	0	**124**	159	142	1	**302**	**441**
2017-11-09 13:30:00	0	17	0	**17**	68	72	0	**140**	121	93	2	**216**	**373**
2017-11-09 13:45:00	3	18	0	**21**	63	59	1	**123**	152	103	1	**256**	**400**
2017-11-09 14:00:00	2	20	0	**22**	71	71	0	**142**	135	116	0	**251**	**415**
2017-11-09 14:15:00	1	17	0	**18**	85	66	0	**151**	132	91	0	**223**	**392**
2017-11-09 14:30:00	1	9	0	**10**	61	79	0	**140**	145	108	0	**253**	**403**
2017-11-09 14:45:00	1	19	0	**20**	69	101	0	**170**	215	118	0	**333**	**523**
2017-11-09 15:00:00	0	12	0	**12**	64	71	0	**135**	194	147	1	**342**	**489**
2017-11-09 15:15:00	0	12	0	**12**	58	54	0	**112**	136	120	0	**256**	**380**
2017-11-09 15:30:00	1	9	0	**10**	82	52	0	**134**	123	150	1	**274**	**418**
2017-11-09 15:45:00	5	13	0	**18**	113	62	0	**175**	120	138	0	**258**	**451**
2017-11-09 16:00:00	0	26	0	**26**	119	63	0	**182**	139	156	3	**298**	**506**
2017-11-09 16:15:00	0	15	0	**15**	153	53	0	**206**	112	126	2	**240**	**461**
2017-11-09 16:30:00	0	24	0	**24**	177	59	0	**236**	134	123	0	**257**	**517**
2017-11-09 16:45:00	1	7	0	**8**	170	37	1	**208**	94	106	0	**200**	**416**
2017-11-09 17:00:00	1	19	0	**20**	136	39	0	**175**	93	68	0	**161**	**356**
2017-11-09 17:15:00	0	25	0	**25**	145	52	0	**197**	88	70	0	**158**	**380**
2017-11-09 17:30:00	0	22	0	**22**	143	54	0	**197**	97	78	0	**175**	**394**
2017-11-09 17:45:00	1	22	0	**23**	104	65	0	**169**	101	73	0	**174**	**366**
Grand Total	43	640	0	**683**	3469	2893	7	**6369**	6024	4481	25	**10530**	**17582**
% Approach	6.3%	93.7%	0.0%		54.5%	45.4%	0.1%		57.2%	42.6%	0.2%		
% Total	0.2%	3.6%	0.0%	**3.9%**	19.7%	16.5%	0.0%	**36.2%**	34.3%	25.5%	0.1%	**59.9%**	
Motorcycles	0	0	0	**0**	0	0	0	**0**	3	1	0	**4**	**4**
% Motorcycles	0.0%	0.0%	0.0%	**0.0%**	0.0%	0.0%	0.0%	**0.0%**	0.0%	0.0%	0.0%	**0.0%**	**0.0%**
Lights	40	596	0	**636**	3431	2859	5	**6295**	3685	4328	23	**8036**	**14967**
% Lights	93.0%	93.1%	0.0%	**93.1%**	98.9%	98.8%	71.4%	**98.8%**	61.2%	96.6%	92.0%	**76.3%**	**85.1%**
Heavy	3	44	0	**47**	38	34	2	**74**	2336	152	2	**2490**	**2611**
% Heavy	7.0%	6.9%	0.0%	**6.9%**	1.1%	1.2%	28.6%	**1.2%**	38.8%	3.4%	8.0%	**23.6%**	**14.9%**

Appendix B

Additional Options

Exhibit AB1: Option D with TNC's in Outside Lanes

Job# 041-18
10/08/18

CBB TRANSPORTATION ENGINEERS+PLANNERS

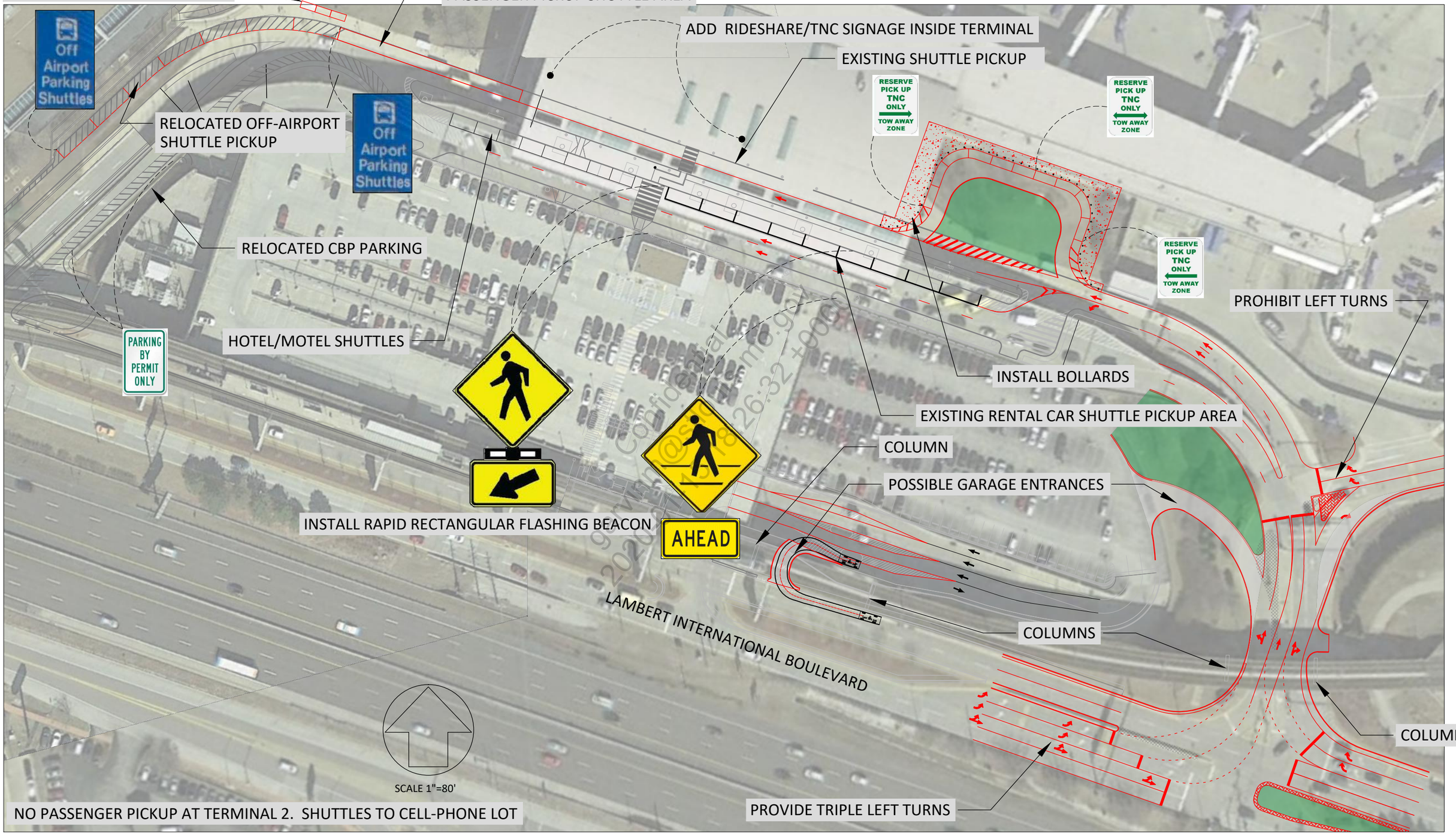

Exhibit AB2: Terminal 2 - Passenger Pickup at Cell-Phone Lot

Job# 041-18
10/08/18

CBB TRANSPORTATION ENGINEERS+PLANNERS

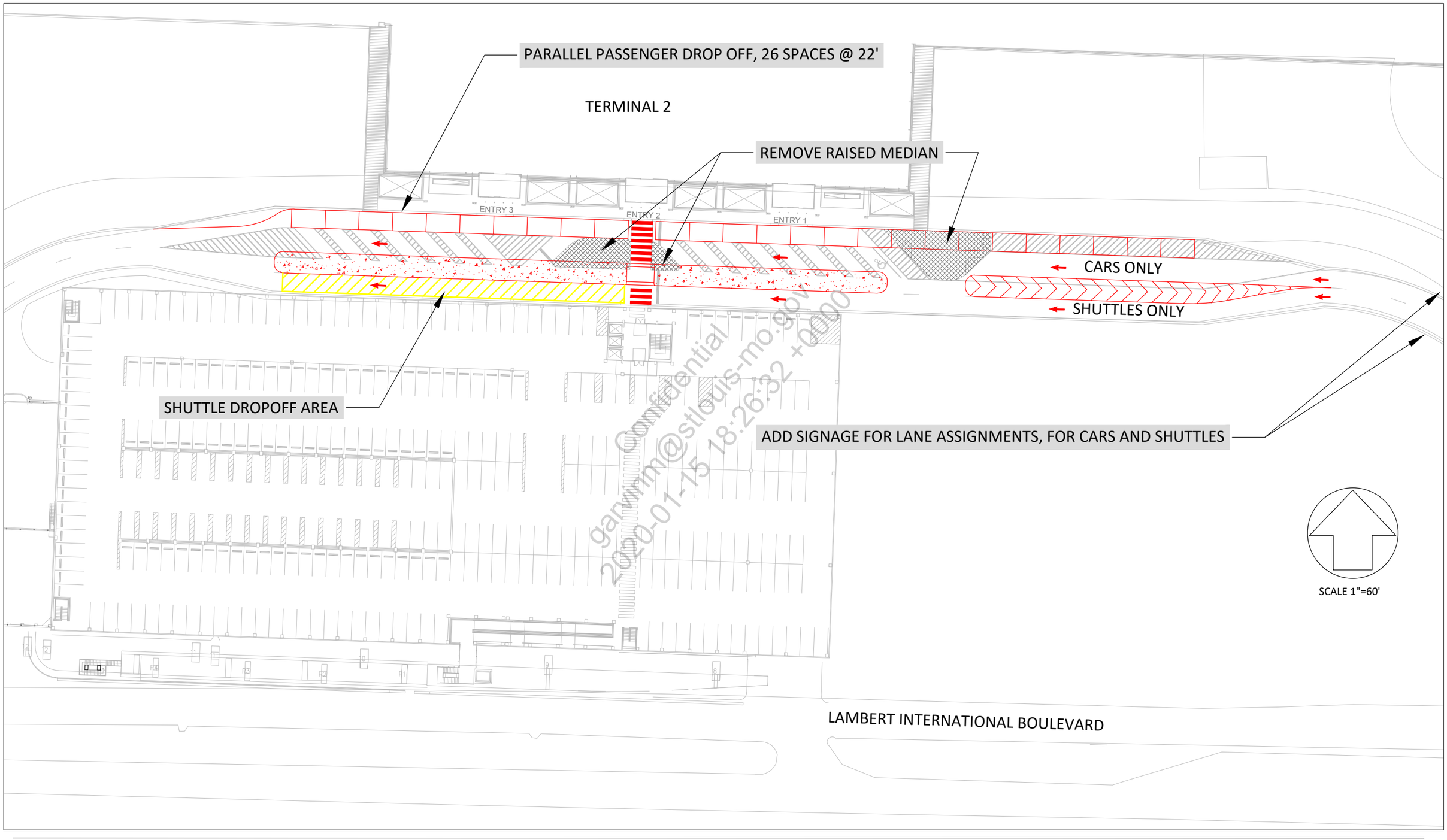

Exhibit AB3: New Drop-off Pattern

Job# 041-18
10/08/18

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October 2018

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