ABC Engineering

Transportation Impact Study Level III

Warehouse Expansion Project
Republic, Missouri

I hereby certify this report was prepared by me or under my direct supervision, and I am a duly Licensed Professional Engineer under the laws of the State of Missouri.

By: _____
(add name), P.E.
License No. (add no.)

Date: _____

Executive Summary

Background:

The warehouse facility at 10095 Dagwood Avenue is reviewing the impacts of full development and occupancy of their new distribution facility located on the southwest corner of the Lexington Parkway/Dagwood Avenue intersection. Currently, the development is roughly 30 percent occupied, with full occupancy occurring as early as next year.

Results:

The principal findings are:

- The current facility is operating at about 30 percent capacity and the associated traffic counts for the site match approximately 30 percent of the expected trip generation from prior studies. The expected full trip generation previously developed remains valid.
- Lexington Parkway is currently at the "nearing capacity" level and above the congested planning level capacity under the long-term scenario.
- Dagwood Avenue is projected to operate with volumes within the nearing capacity levels under the short-term and long-term scenarios with the full occupancy of the warehouse facility. The facility contributes to the need for four-lanes, but is not the sole cause of that need.
- No issues arise at any of the study intersection in the a.m. peak hour with all queuing and delays remaining below the acceptable bounds.
- Congestion becomes a concern in the p.m. peak hour for both the Dagwood Avenue/Lexington Parkway and State Highway GG/Lexington Parkway intersections.
- Queuing at the existing access to Dagwood Avenue is a concern in the p.m. peak hour during the existing distribution short-term scenario with northbound right queues at 12 vehicles:
    - These queues magnify under the proposed driveway utilization layout restricting all employees to the Dagwood Avenue access only.
    - These queues only occur to employees on the site property and do not impact the public roadways.
    - If/when Dagwood Avenue is expanded to a four-lane facility, these queues are greatly reduced.
- While the northbound left turn truck movement is expected to operate with longer delays than desired during peak periods, the truck stacking remains reasonable and is expected to stay within its storage lane capacity.
- As volumes on Lexington Parkway and the site access continue to increase, the slower truck acceleration and longer vehicle length could become an operational concern:
    - The Westmere Drive extension to State Highway GG will help to reduce these queues.
    - The delays and queues are internal to the site.
    - The characteristics of the truck traffic is a differentiating factor compared to the Dagwood Avenue access.

- The proposed parking supply exceeds the City's minimum requirements and the expected demand for the site.
- Bicycle parking is not currently shown on the plan.
- Sufficient space is available for sidewalks adjacent to surrounding roads, but outside the proposed security fence.
- Two options are available for secondary access to the proposed employee only parking area.
- Sight distance at the existing access driveways exceeds the requirements.

Recommendations:

The following recommendations are made based on the above findings:

- Continue to monitor volumes on Dagwood Avenue and Lexington Parkway to determine when expansion to a four-lane and six-lane roadway is required.
- Retime all traffic signals at least every three years.
- Provide dual left turn lanes for westbound State Highway GG traffic at Lexington Parkway.
- Provide dual left turn lanes for eastbound Dagwood Avenue traffic at Lexington Parkway as well as separate left turn, through, and right turn lanes for the westbound approach.
- Continue to monitor queue lengths at the Lexington Parkway truck access to determine if and when additional traffic control or rerouting of outbound left turn truck traffic during the peak periods is necessary.
- Provide ten to 12 bicycle parking stalls initially, with area for potential expansion if and when specific bicycle facilities are constructed near the site.
- Remain open to transit opportunities when they arise.
- Construct sidewalks around the site, expanding the public network with a connection to the proposed customer service building.
- Adjust the site plan for an internal gated access on the west side of the employee parking area to allow for access to the Westmere Drive driveway if needed.
- Continue to explore the feasibility of a connection to the east, providing a right-in/right-out access on Lexington Parkway as a secondary access to the employee parking area.

The prior conclusions and recommendations of previous studies remain valid. Right-of-way for long-term improvements should be reserved to reduce future costs and complications.

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1. Introduction

a. Purpose of Report

The warehouse facility at 10095 Dagwood Avenue in the City of Republic, Missouri was initially constructed several years ago. The large campus is surrounded by Dagwood Avenue to the north, Lexington Parkway to the east, State Highway GG to the south, and Westmere Drive to the west.

Currently about 30 percent occupied, the owner is reviewing the impacts of full development and occupancy of their new distribution facility, with full occupancy occurring as early as next year.

The purpose of this study is to determine the transportation impacts associated with the proposed build-out of the development and the revised access plan for the site. This report will satisfy the City of Republic's requirements and follows the general guidelines for this type of evaluation. Based on the preliminary assessment for the site, provided in the Appendix, and discussions with the City, this document is a Tier 3, Level II Transportation Impact Study (TIS).

b. Study Objectives Summary

Based on the TIS guidelines, the study objectives are:

i. Document how the study intersections and roadways currently operate under 30% occupation of the facility.
ii. Forecast the amount of traffic to be generated by the expected full operation of the facility.
iii. Examine the relationship to existing area planning documents.
iv. Determine how the study intersections and roadways will operate in the future under short-term (one-year) and long-term (ten-year) conditions.
v. Review the proposed access restriction and impacts on operations.
vi. Evaluate the parking needs.
vii. Complete a site review, including multi-modal opportunities.
viii. Analyze the sight distance at each access driveway.
ix. Recommend appropriate mitigation measures if necessary.

Although this study generally follows guidelines for a Tier 3, Level II study, discussions with the impacted public agencies reduced the study area. Recent studies and planned improvements to indicate the impacts of increased development and traffic in the area were reviewed. With the most recent study completed last year, the need to restudy in this close timeframe is eliminated.

As discussed, the primary corridors studied include the following around the proposed site:

- Dagwood Avenue (County Road 200).
- Lexington Parkway.
- State Highway GG.

The study intersections closest to the proposed development and where the greatest impact is expected were chosen for review. This list includes:

- Dagwood Avenue/Lexington Parkway.
- State Highway GG/Lexington Parkway.
- Dagwood Avenue/Employee only access.
- Truck Access/Lexington Parkway.

It should be noted traffic expected from the proposed development will have minor impacts on other corridors and intersections beyond those studied here. Furthermore, this study does not account for the existing roadway conditions such as pavement quality or appropriate drainage.

2. Development Site

a. *Existing Site*

The existing warehouse facility is open and operating at approximately 30 percent of full occupancy according to the owner. The site is zoned M1 – Light Industrial District and will remain under this zoning. The use on this site is consistent with its zoning.

Access is currently provided through four driveways:

- A southern access to Westmere Drive for truck use.
- A northern access to Westmere Drive for employee use.
- An access to Dagwood Avenue for employee use.
- An access to Lexington Parkway for truck use.

The access driveways are all under side-street stop sign control with the public roadway traffic able to proceed without stopping.

b. *Proposed Development*

The owner proposes to complete the warehouse facility allowing for full occupancy as well as construction of two small buildings. The following are key attributes of the proposed development completion:

- Access to the site will continue to be provided via driveways on Dagwood Avenue, Lexington Parkway, State Highway GG, and Westmere Drive.
- A potential fifth driveway to Westmere Drive will not be constructed and future rights for this access relinquished.
- The use of two driveways will change, restricting employee access to the single driveway connection to Dagwood Avenue only.
- Construction of a customer service/employee access building and a separate truck wash.
- Internal changes to allow for 360-degree truck access, meaning trucks will be able to use any access and still reach their docking bay.
- The proposed development will increase from 30% occupancy to 100% occupancy of the 932,837 square foot building.
- Expansion of employee parking from 698 today to 879 spaces in the future.

Construction is expected to occur immediately, assuming proper approvals, with full occupancy achieved by next year. For the purposes of this study, the impacts will be studied under a short-term (one year) scenario and a long-term (ten year) scenario.

3. Existing Conditions

a. Corridor Characteristics

As mentioned, the proposed site is located on the southwest corner of the Lexington Parkway/Dagwood Avenue intersection. Table 1 shows the characteristics of the key roadway corridors around this site and within the study area.

Table 1 – Study Corridor Characteristics

Name	Designation[1]	Classification[2]	Speed Limit	Daily Traffic Volume[3]	Lanes	Fixed Route Transit[4]	Ped/Bicycle Facilities
Dagwood Avenue W of Lexington Pkwy E of Lexington Pkwy	CR 200	Collector	40 mph	11,400 3,400	3-Undivided	None	Sidewalk on both sides
Lexington Pkwy N of Dagwood Ave Lexington to SH GG S of SH GG	-	Primary Arterial	45 mph	7,600	4-Divided	None	Sidewalk on east side
State Highway GG W of Lexington Pkwy E of Lexington Pkwy	SH GG	Primary Arterial	45 mph	13,800	4-Divided	None	None
Westmere Drive[5] S of Dagwood Ave	-	Local	30 mph	N/A	3-Undivided	None	None

[1] SH = State Highway, CR = County Road
[2] Springfield – Greene County Comprehensive Plan and amendments
[3] Vehicles per day
[4] Number of routes around the proposed site followed by the frequency of transit service during the peak periods
[5] Westmere Drive is currently a dead-end road with access to development only, construction next year will complete a connection to State Highway GG

b. Transit

Transit service does not yet extend to this area.

c. Pedestrians/Bicycles

Sidewalks are provided on Dagwood Avenue, both sides. Pavement markings, pedestrian push buttons, and countdown timers are provided at the signalized intersections. ADA compliant sidewalk ramps are provided at the major street intersections as well as driveway intersections in the study area.

There are no designated bicycle facilities in this study area.

d. Traffic Volumes

Intersection video was collected at the existing study intersections under normal weekday conditions in Month Year. Using these videos, 48-hour turning movement counts were obtained at the study intersections. The data from the two days was

averaged to provide the base traffic for a “typical weekday” averaging out any irregularities between the collected periods.

Table 2 shows the current daily traffic based on the “typical day” turning movement volumes. For comparison purposes, the latest volumes from the online traffic data source are also shown. Note the locations of the previous data are not always next to the intersections of the current counts. In general, volumes are higher on all roads and sections except State Highway GG, which shows a significant decrease.

Table 2 – Study Corridor Daily Volumes

Name	Location	Current Count	20XX - 2 ADT[1]	20XX - 4 ADT[1]
Dagwood Avenue	West of Lexington Pkwy	11,400	5,565	7,824
Dagwood Avenue	East of Lexington Pkwy	3,400	2,837	N/A
Lexington Pkwy	North of Dagwood Ave	19,900	17,520	16,637
Lexington Pkwy	Dagwood Ave to State Highway GG	27,600	21,694	N/A
Lexington Pkwy	South of State Highway GG	30,900	25,450	19,167
State Highway GG	West of Lexington Pkwy	21,100	35,632	N/A
State Highway GG	East of Lexington Pkwy	24,200	N/A	29,026

[1] Online Traffic Data

Chart 1 shows the hourly volume on Lexington Parkway between the intersections with Dagwood Avenue and State Highway GG. The average a.m. and p.m. peak hours were found to be from 7:15 to 8:15 a.m. and 4:30 to 5:30 p.m. A minor peak also occurs around noon.

Chart 1 – Lexington Parkway Hourly Volume Distribution

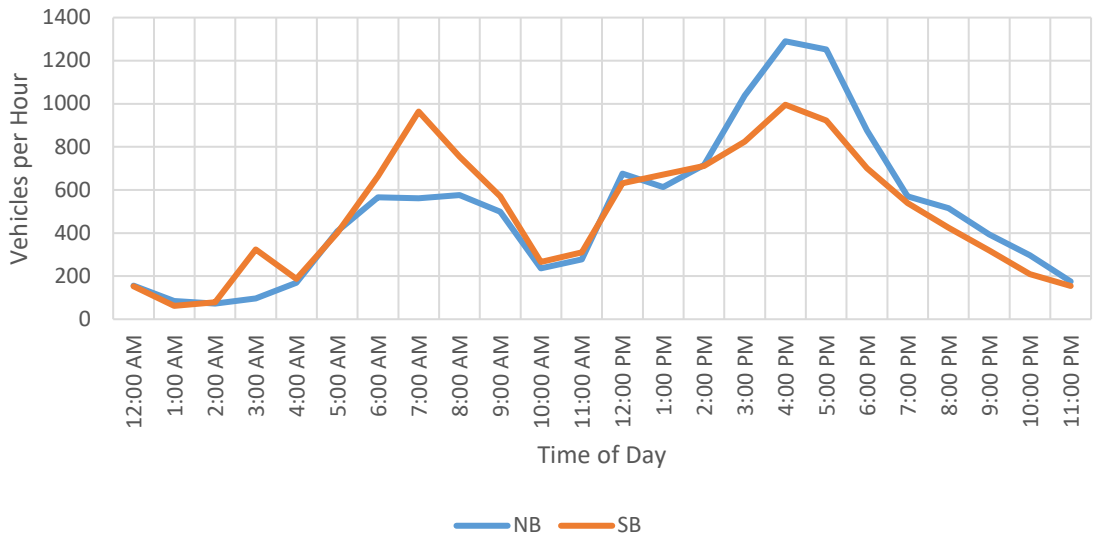
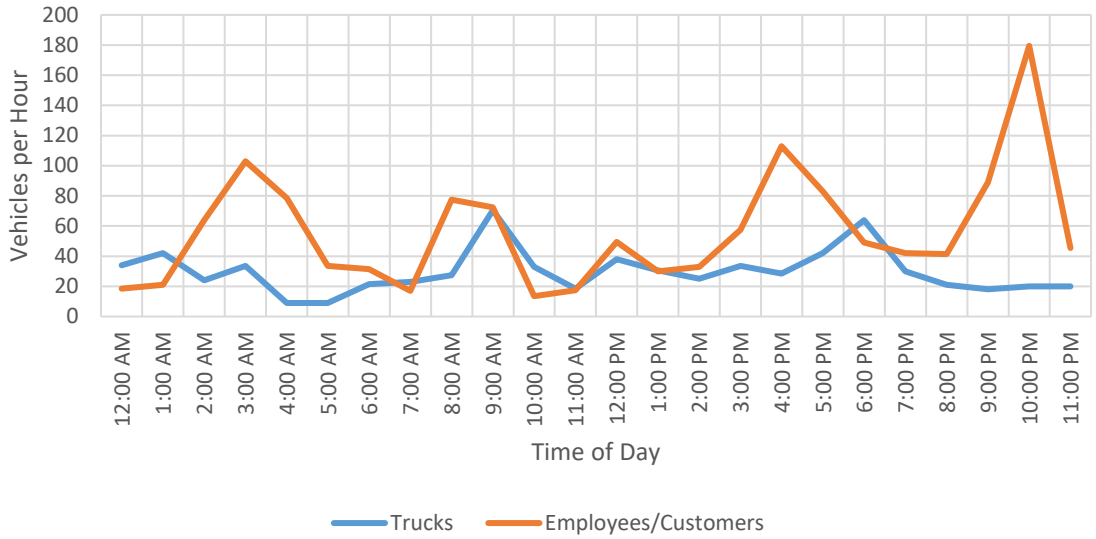


Chart 2 shows the hourly volume of traffic currently entering and exiting the warehouse facility. The existing traffic is divided between the truck and

employee/customer volumes. As shown, the peaks vary from the standard commuter timeframe. The trucks show peaks in the early morning (after 1 a.m.), after the morning rush (post 9 a.m.), and at the end of the evening rush (close to 6 p.m.). The employee traffic is close to the standard rush hours, with addition peaks around 3 a.m. and 10 p.m.

Chart 2 – Site Access Hourly Volume Distribution



Based on these volume counts, two peak hours were selected for further review and analysis in this study. The first is 9:00 to 10:00 a.m. hour, which provides for some background traffic on the study roads and peak entries/exits from the warehouse facility. The second is the standard p.m. peak hour (4:30 to 5:30 p.m.), which covers the highest volumes on the study corridors with a moderate amount of traffic from the warehouse facility.

The turning movement count data from the counts are contained in fifteen-minute intervals in the Appendix.

4. Forecasted Traffic

a. *Site Traffic Forecasting*

Table 2, below, presents the expected full occupation trip generation as provided by the owner.

Table 2 – Full Occupation Trip Generation

	0.00 1.00	1.00 2.00	2.00 3.00	3.00 4.00	4.00 5.00	5.00 6.00	6.00 7.00	7.00 8.00	8.00 9.00	9.00 10.00	10.00 11.00	11.00 12.00	12.00 13.00	13.00 14.00	14.00 15.00	15.00 16.00	16.00 17.00	17.00 18.00	18.00 19.00	19.00 20.00	20.00 21.00	21.00 22.00	22.00 23.00	23.00 24.00	
Total Inbound Trailers	55	18	10	25	25	17	3	2	20	20	25	25	50	25	57	65	95	71	25	40	40	60	130	90	993
Total Outbound Trailers	20	35	65	123	15	15	25	2	30	59	50	50	75	50	62	50	70	22	0	15	35	35	65	25	993
Total Trailers In/Out	75	53	75	148	40	32	28	4	50	79	75	75	125	75	119	115	165	93	25	55	75	95	195	115	1,986
# Inbound Pkg Cars																		40	150	50	16				
# Outbound Pkg Cars									150	106															
Total Package Cars In/Out	0	0	0	0	0	0	0	0	150	106	0	0	0	0	0	0	0	40	150	50	16	0	0	0	512
# Employees Arriving (Operations)			25	320	100		25	64	228	50	75	325	91	20		75	75	331				42	325	50	
# Employees Arriving (Staff)				25			25	50										25							
# Employees Leaving (Operations)			225	150	42			125	270	25	25				14	86	325	75	50	233	95	200	206	75	
# Employees Leaving (Staff)				25											25			25	25	25					
Total Pasenger Cars In/Out	0	0	250	520	142	0	50	239	498	75	100	325	91	20	39	161	400	456	75	258	95	242	531	125	4,692
Total Traffic Entering Site	55	18	35	370	125	17	53	116	248	70	100	350	141	45	57	140	170	467	175	90	56	102	455	140	
Total Traffic Leaving Site	20	35	290	298	57	15	25	127	450	190	75	50	75	50	101	136	395	122	75	273	130	235	271	100	
Total Traffic In/Out	75	53	325	668	182	32	78	243	698	260	175	400	216	95	158	276	565	589	250	363	186	337	726	240	7,190

Knowing the existing development is operating at roughly 30 percent capacity, 30 percent of the full occupation daily trip generation was checked against the existing daily trip generation collected in the turning movement counts. This comparison showed the existing trip generation is roughly 25 percent of the above determined full occupancy.

The existing counts did not include the two facility accesses on Westmere Drive to the west of the development, which can be used for both truck and employee movements. Most warehouse traffic is destined for Lexington Parkway to access other major roads. As such, and due to the location of these Westmere Drive accesses as well as Westmere Drive not currently connecting to the south, little incentive exists for drivers to travel out of their way through these western accesses to then proceed north/south on Lexington Parkway. Therefore, only about three percent of the site traffic is expected to use these access points under the existing roadway configuration. Adding this small amount of traffic to the existing counts supports the full occupancy trip generation as an accurate depiction of full use of this facility. This trip generation is assumed accurate and used for this study.

On an hourly basis, the existing traffic counts did not match the forecasted trip generation. The variation in existing to forecasted trip generation can be explained by likely assumptions in the forecasted data, such as times of employee shifts and expected times of truck travel. As mentioned earlier, these fluctuations do balance out throughout the day.

To forecast the full occupancy using the trip generation previously developed, the final volumes were slightly shifted to match our peaks. The resultant peak hour trips generated by the proposed development for this analysis are shown in Table 3.

Table 3 – New Trip Generation

Trip Type	AM Peak Hour		PM Peak Hour	
	In	Out	In	Out
Employee Trips	228	270	75	325
Package Truck Trips	0	150	150	0
Trailer Truck Trips	20	59	95	70
TOTAL	**248**	**479**	**320**	**395**

A trip distribution pattern was developed for the generated traffic going to and from the proposed development. This pattern is based on previous studies and found to remain valid. The general trip distribution pattern for this study is:

i. 21% of the generated traffic to/from the west on Dagwood Avenue.
ii. 46% of the generated traffic to/from the north on Lexington Parkway.
iii. 7% of the generated traffic to/from the east on Dagwood Avenue.
iv. 13% percent of the generated traffic to/from the south on Lexington Parkway.
v. 13% of the generated traffic to/from the west on State Highway GG.

Traffic generated by the site development was assigned to the area roadways per this distribution pattern.

It is worth mentioning that a shift in specific travel routes is expected when Westmere Drive is extended south to intersect with State Highway GG. This future connection, which is expected to begin construction soon, will not change the trip distribution's origin and destination points. However, specific routes some employees and trucks use to enter and exit the development will change. The largest shift is expected for drivers to and from the west on State Highway GG. These drivers will use Westmere Drive instead of Lexington Parkway, which should help reduce the traffic levels on Lexington Parkway as well as distribute traffic more evenly around the development.

b. Non-site Traffic Forecasting

Based on discussions with the City and previous studies in the area, a 2 percent background growth rate was applied to the 2019 scenario, and a background growth rate of 20 percent was applied for the 10-year forecast. These growth rates were applied to all through movements and those movements not directly entering the development, as all growth associated with the development was accounted for in the trip generation.

c. Total Traffic

Traffic forecasts were developed for the one-year and ten-year forecast scenarios by adding the traffic generated by the full occupancy of the warehouse to the non-site forecast volumes. The average daily traffic volume forecasts developed through this process are shown in the Capacity Analysis Backup section of the Appendix.

5. Relationship to Existing Planning

a. Ozarks Transportation Organization Major Thoroughfare Plan

The proposed development does not alter the surrounding roadway system, which already matches the thoroughfare plan. Access points around the development are also the same.

The proposed development is therefore consistent with this planning document.

b. Greene County Vision 20/20

The Vision 20/20 Citizens group and its Transportation Focus Group worked to identify principles and policies for the Springfield-Greene County Transportation Plan. These principles serve as a summary of the transportation values of the community and provided guidance for the development of this document. The following transportation planning principles were considered to ensure the proposed development fits within the long-term transportation goals:

1. Economy and Quality of Life: Direct regional transportation investments and implement the Land Use and Growth Management Plan and strategies to support the economy and quality of life in the Springfield-Greene County urban area.
2. Plan Consistency: Make regional transportation investments consistent with this Transportation Plan.
3. Roadway Efficiency: Ensure the Springfield-Greene County urban area roadway system is built and designed to maximize system efficiency, serve travel demand, provide for user safety, and integrate and enhance other travel modes.
4. Access Control: Provide an access-controlled roadway system, where necessary and feasible, based on land use, traffic demand, safety and cost.
5. Road Right-of Ways: Define and officially map rights-of-way for planned future highways and arterials within planned corridors, and where necessary, acquire right-of-way prior to development.
6. Transit: Promote the use of transit through incentives.
7. Travel Demand: Reduce the need for additional roadway capacity and maximize energy efficiency during peak hours through ridesharing, conventional transit, pedestrian and bicycle use, improved land use patterns, development site design, and Transportation System and Demand Management (TSM/TDM) strategies.
8. Bicycle and Pedestrian Systems: Develop and maintain safe, high-quality, continuous, barrier-free bicycle and pedestrian systems to function as integral parts of the area's transportation system.
9. Freight: Maintain a competitive freight transportation system including the region's commercial motor carriers, railroads, air cargo carriers, and intermodal

connections in order to provide effective linkages to state, national and international markets. Design appropriate roadways to accommodate trucks and encourage the Missouri Legislature and MODOT to improve highway connections to other major cities, especially Kansas City and Memphis. Support airport development and the improvement of rail connections, trucking connections, inter-city bus, and the development of intermodal center.

10. Planning Coordination: The planning decisions and implementation of transportation programs and projects should be consistent with federal, state and regional environmental regulations, standards, programs and policies.
11. Public Participation: Promote public participation in formulating transportation policy and implementing transportation decisions.
12. Paratransit: Encourage the provision of paratransit and not-for-profit transportation services within the Springfield area, particularly to the populations not served by the transit system.

As subsequent sections of this document will show, the entire transportation system is evaluated for potential improvements. Thus, the proposed development and suggested mitigation conforms to the principles of this planning document.

c. Christian County Comprehensive Plan

Christian County established various goals for itself as part of the Comprehensive Plan for the County. The overall Transportation Goal is to "provide and maintain a quality transportation system that emphasizes safety, cost effectiveness and connectivity while remaining consummate to a diverse range of land use patterns."

The following objectives support this goal:

- Address transportation safety, capacity and adequacy in the development decision-making process.
- Coordinate with the Road Districts to ensure that road construction and maintenance is consistent with existing and future traffic patterns.
- Require development to design and construct adequate internal road systems that are integrated with the existing and future roads and consistent with the County's thoroughfare plan.
- Support and encourage increased efforts and resource allocation from the Missouri Highway and Transportation Department to meet the current and projected transportation system needs of the County.

This document represents efforts of the proposed expansion to be consistent with the County's Transportation Goal and follow the objectives to meeting that goal.

d. City of Republic Comprehensive Plan

The City of Republic is currently updating its Comprehensive Plan to provide an all-inclusive cohesive document, allowing Planning, Municipal Utilities, and Parks, as well as various sub-elements, to work in concert. This project is a major update of

the previous plan with increased coordination between the elements and a common vision of the future for the City. Work on the final product has just begun and is not yet available for full review with this study.

The Mission ("We will be aggressively progressive through Processes, Relationships and Trust") and the Vision ("To grow together by always doing the Right Thing at the Right Time for the Right Reason") have been publicized along with values for the City. This document recognizes these planning elements and is consistent with those values in seeking approval for the proposed expansion.

6. Traffic Evaluation

a. Corridor Vehicular Analysis

While many factors contribute to a road feeling congested, the two biggest factors are volume, how many vehicles are using the road, and capacity, how many vehicles the road can accommodate a day. Transportation professionals use these pieces of information to create a ratio of volume to capacity. For example, a road with a volume to capacity ratio of 1.0, where the traffic demand is nearly equal to the traffic supply, will feel congested to motorists.

Below is a rough guide of the daily traffic volumes different types of roads can accommodate based on Exhibits 16-16 and 12-39 of the *Highway Capacity Manual, 6th Edition*. If the Average Daily Traffic (ADT) volume on a roadway is below the threshold, then it is considered un-congested. If the daily volume falls inside the range, the road is almost congested, and if the daily volume is over the threshold the road is congested.

- 2-Lane (one in each direction with left turn lanes at busy intersections and coordinated signals), undivided street, are considered congested with a volume between 8,900 to 18,300 vehicles per day.
- 4-Lane, undivided street (two in each direction with left turn lanes at busy intersections and coordinated signals), – 18,600 to 36,800 vehicles per day.
- 6-Lane, divided street (three in each direction with left turn lanes at busy intersections and coordinated signals), – 29,100 to 55,300 vehicles per day.

In comparison, Springfield/Greene County have developed their own road capacity/level of service guidelines for daily volumes by classification and type of road:

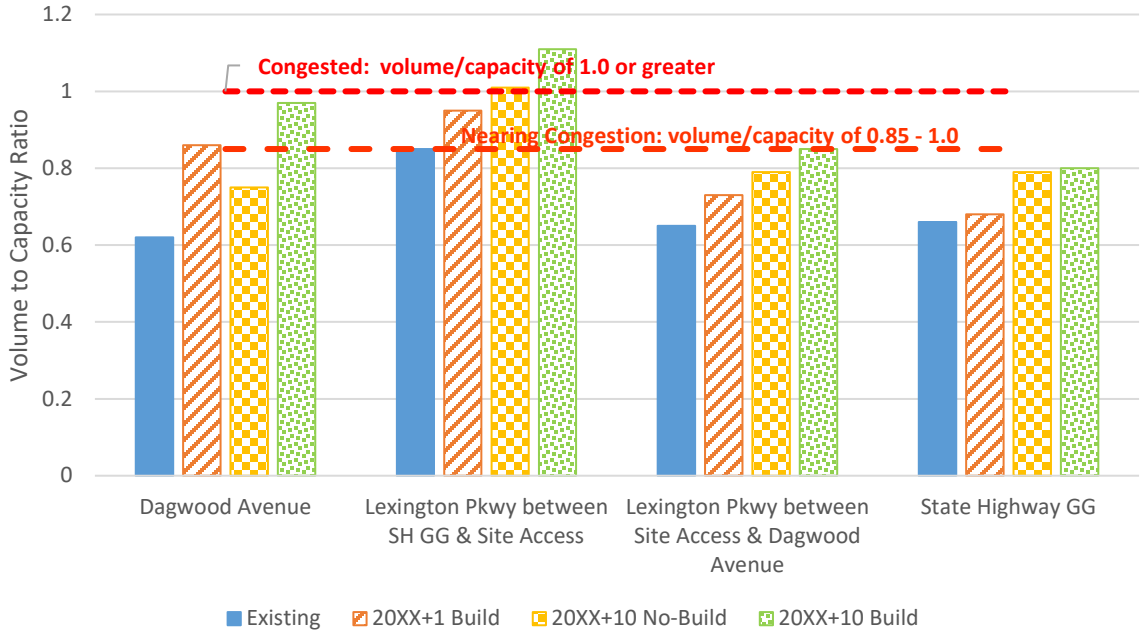
- 6-Lane, divided arterial – 39,000 vehicles per day.
- 4-Lane, divided arterial – 26,000 vehicles per day.
- 5-Lane, undivided arterial – 24,600 vehicles per day.
- 4-Lane, undivided arterial – 17,600 vehicles per day.
- 3-Lane, undivided arterial – 12,800 vehicles per day.
- 2-Lane, undivided arterial – 9,000 vehicles per day.
- 5-Lane, secondary arterial – 22,600 vehicles per day.
- 4-Lane, secondary arterial – 15,400 vehicles per day.
- 3-Lane, secondary arterial – 11,200 vehicles per day.
- 2-Lane, secondary arterial – 7,800 vehicles per day.
- 5-Lane, collector arterial – 19,600 vehicles per day.
- 4-Lane, collector arterial – 14,400 vehicles per day.
- 3-Lane, collector arterial – 9,400 vehicles per day.
- 2-Lane, collector arterial – 6,600 vehicles per day.

The above capacities represent physical capacity in ideal roadway conditions. Research from UC Berkley, for example, indicates quality of life along a residential street is negatively impacted when the ADT exceeds 1,000 vehicles per day.

Therefore, the 1,000 vehicles per day threshold is used for the capacity along neighborhood two lane roads even though its physical capacity is approximately ten times larger.

To provide an initial planning level screening, Chart 3 provides volume to capacity ratios of the study corridors during each of the study years to determine if any of the roadway corridors are candidates for additional through lanes.

Chart 3 – Study Corridor Volume to Capacity



As Chart 3 shows, all roadways are projected to operate below congested volumes except for Lexington Parkway between the intersections with State Highway GG and with the Site Access. This roadway is projected to reach just above capacity by the 2028 No-Build scenario and operate with roughly 10% above capacity volumes with full occupancy of the warehouse facility. All other roadways analyzed begin to reach the nearing congestion boundary by the 2028 build scenario, with Dagwood Avenue reaching these volumes with 2019 full occupancy volumes.

These results reflect the conclusions from prior studies in the area and suggest that expansion of Lexington Parkway to a six-lane facility could be necessary in the future along with an expansion of Dagwood Avenue to a four-lane facility. It is important to note that these vehicle volumes are not solely due to the addition of the warehouse facility traffic as background growth and various other proposed developments surrounding the project area also contribute to the congested volumes.

b. Intersection Vehicular Analysis

Individual intersections can perform poorly during peak periods while the overall roadway corridor is operating with an uncongested daily volume to capacity ratio lower than 1.0. Therefore, capacity analyses are performed for the study intersections to determine if they need improvements such as turn lanes or an upgrade in traffic control.

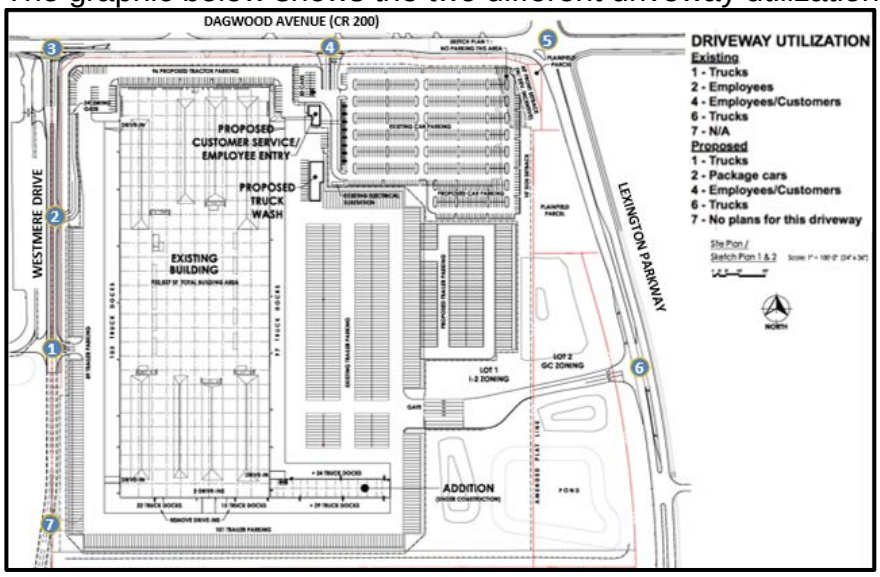
The existing and forecasted turning movement volumes along with the existing intersection configurations and traffic control were used to develop the average delay per intersection in each study scenario. The delay calculations were done in accordance with the *Highway Capacity Manual, 6th Edition* using the Vistro software package. The full calculations for each study scenario, including Level of Service (LOS) grades and queue lengths, are included in the Appendix. Also, included in the Appendix is a guide explaining the Level of Service grade concept.

Two distribution analyses were reviewed for each peak period. The first being distribution based on the existing access characterizations and the second based on proposed modifications. The proposed modifications are put forth for safety reasons as they help create internal circulation that fits with the developments preferred security and safety protocols. These two cases are as follows:

i. **Existing Distribution –** All truck movements through the accesses on Lexington Parkway and the southern access on Westmere Drive. All employee movements through the accesses on Dagwood Avenue and the northern on Westmere Drive. All customer movements through the access on Dagwood Avenue.

ii. **Proposed Distribution –** All truck movements through the accesses on Lexington Parkway and the southern access on Westmere Drive as before. All employee and customer movements through the accesses on Dagwood Avenue only. Package car movements through the northern access on Westmere Drive.

The graphic below shows the two different driveway utilization options.



The main difference in the existing and proposed distribution is with respect to consolidating all employee and customer movements through the driveway onto Dagwood Avenue.

Also, as mentioned previously, analysis was preformed assuming the Westmere Drive extension to State Highway GG is completed for both the short-term and long-term scenarios. This extension results in a shifting of vehicles from Lexington Parkway to Westmere Drive.

Chart 4 (a.m. peak hour) and Chart 5 (p.m. peak hour) show the average peak hour delay per traffic signal-controlled intersection for each study scenario. The LOS D/E boundary of 55 seconds of delay per vehicle is generally considered the threshold between acceptable and unacceptable traffic operations.

Chart 4 – A.M. Peak Hour Delays: Signal Controlled Intersections

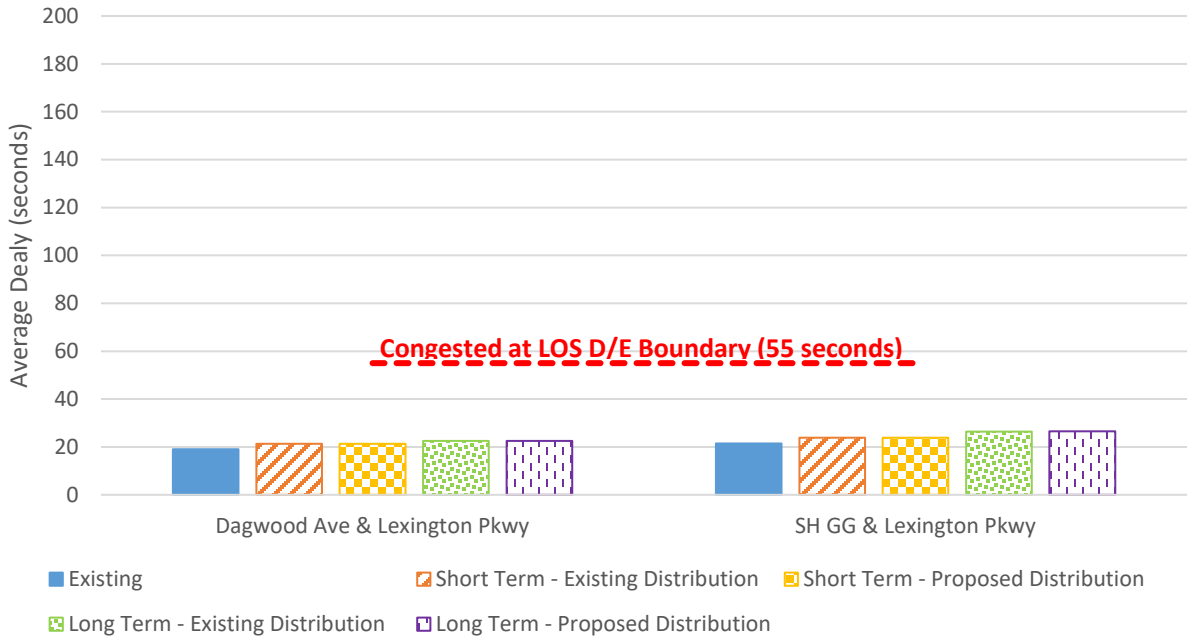
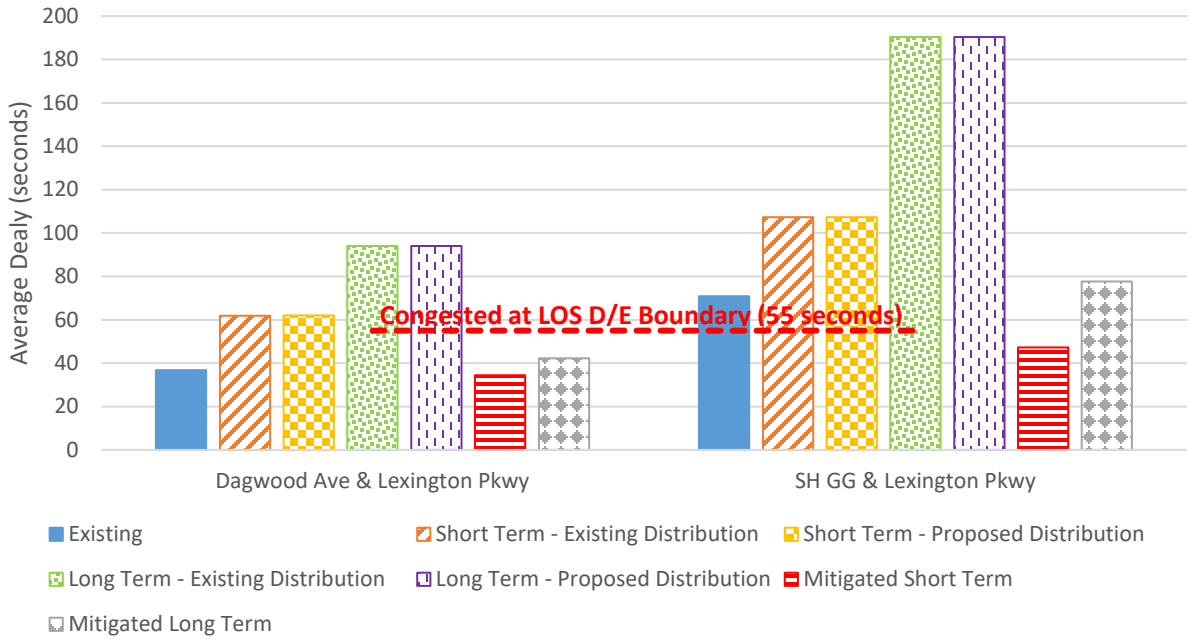


Chart 5 – P.M. Peak Hour Delays: Signal Controlled Intersections



As Chart 4 shows, all signalized intersections operate within the acceptable boundaries in the a.m. peak hour under all future scenarios. However, during the p.m. peak period operations begin to worsen. At the Dagwood Avenue/Lexington Parkway intersection, the existing volumes operate at a LOS D, with failing grades occurring with full operation of the facility. This congestion is due to the heavy eastbound turning volumes as well as the existing left and shared through-right layout of the westbound leg. The State Highway GG/Lexington Parkway intersection is currently operating at a LOS F. As mentioned in the corridor study, the vehicular volumes are above the planning level capacity of a four-lane roadway, which contributes to these delays. Due to the high volumes on all approaches large delays are experienced as each phase movement requires significant green time.

Based on these results the following mitigation is recommended:

i. **Dagwood Avenue & Lexington Parkway –** Retime the traffic signal and add dual eastbound left turn lanes as well as separate left turn, through, and right turn lanes for the westbound approach. This layout reduces the experienced delays to LOS D or better for the short-term and long-term forecast scenarios as shown in Chart 5, above.

ii. **Lexington Parkway & State Highway GG –** Retime the traffic signal and add dual westbound left turn lanes, providing two left turn lanes, two through lanes, and a right turn lane for each approach. This layout reduces the experienced delays to LOS D for the short-term forecast and LOS E for the long-term forecast. The long-term forecast is still above the preferred LOS boundary. However, future roadway improvements as well as changes in proposed developments can significantly impact traffic patterns. Continued monitoring of the intersection is recommended to determine when additional

mitigation, like six-lanes on Lexington Parkway, is necessary based on actual development of the area and associated traffic volumes.

Chart 6 (a.m. peak hour) and Chart 7 (p.m. peak hour) show the 95th percentile queue lengths on the busiest stop sign controlled approach at intersections with side street stop sign control. Average delays are not used for intersections with side street stop sign control because the vast majority of vehicles going through the intersection are on the main roadway and have zero delay, which leads to low overall average delays. At side street stop sign controlled approaches to busy roadways, the average delay for all the vehicles on the approach often exceeds 60 seconds. This can be the case for a few vehicles waiting at the stop sign where improvements would not be justified for the low traffic volume.

Based on our experience, improvements are not warranted at these types of intersections until the 95th percentile queue at a stop sign is in the five to ten vehicle range.

Chart 6 – A.M. Peak Hour Queues: Side Street Stop Sign Controlled Intersections

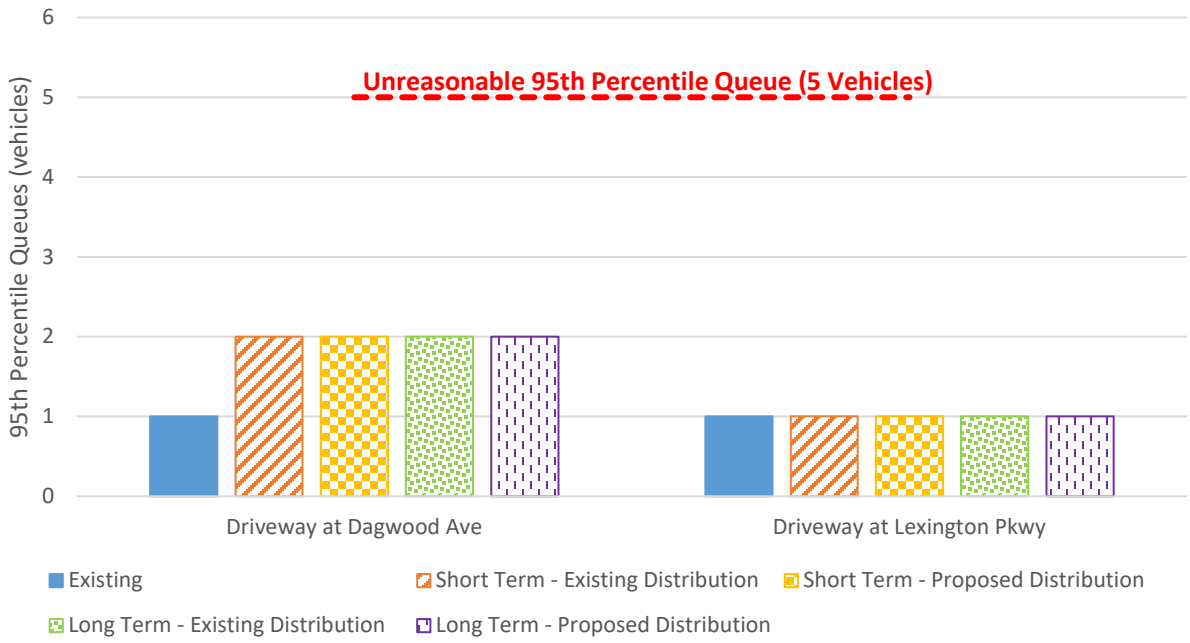
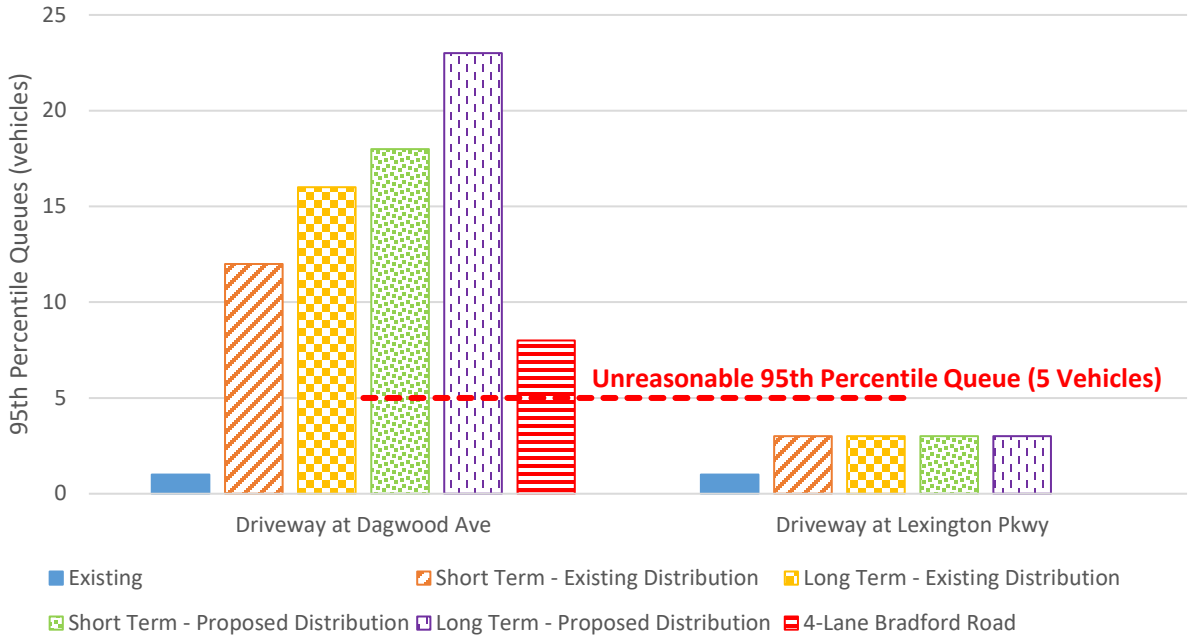


Chart 7 – P.M. Peak Hour Queues: Side Street Stop Sign Controlled Intersections



Similar to the signalized intersection analysis, all site accesses operate with acceptable queuing in the a.m. peak hour with issues arising in the p.m. peak hour. The access driveway onto Dagwood Avenue begins to see larger than preferred queuing for the exiting right turning traffic due to the volume of vehicles completing the movement. This movement becomes worse in the proposed distribution as all employee and customer movements would be restricted to the access.

Based on these results, the proposed distribution restricting employee access to one location means:

- Long exiting queues and delays as employees would not have an optional route to exit the facility.
- Acceptable entering traffic and operations on the public roads.

The proposed distribution plan does not represent an impact to the public roadway operations. Instead, the owner would need to deal with any mitigation or management of the internal impacts. Suggestions for proposed expansion should the proposed distribution plan be enacted are:

- Provide for two outbound lanes, one left turn lane and one right turn lane, with sufficient stacking distances before internal intersections.
- Stagger shift changes to the degree possible to reduce peak exiting.
- Consider other options to encourage carpooling and alternative means of travel like walking, bicycling, and transit use.

As Dagwood Avenue is nearing capacity, operations during the p.m. peak hour were re-analyzed assuming a potential expansion of Dagwood Avenue to a four-lane

corridor. This geometry results with significant improvements in queuing with only eight vehicles in the northbound queue. These results suggest that if/when Dagwood Avenue is expanded to a four-lane corridor, significant queueing improvements are expected on the Dagwood Avenue driveway under the proposed site distribution.

The truck access on Lexington Parkway was also reviewed further due to potential concerns related to larger truck movements. Due to their slower acceleration times and extended length compared to passenger cars, longer gaps in mainline traffic are necessary to complete turning movements across conflicting traffic. This situation could become a concern as volumes along Lexington Parkway and to/from the development continue to grow. However, with the extension of Westmere Drive to State Highway GG, the truck traffic will have increased travel options around the site. The truck access to Westmere Drive should be checked to ensure trucks can easily move to and from the north and south on Westmere Drive.

The forecasted future of this report suggests high delays (several minutes) for the exiting left turn movement, LOS F, although the 95th percentile queue is about three trucks. The northbound left turn entry in the site is also at LOS F, although delay is less than 60 seconds and the 95th percentile queue is less than three vehicles and within the provided left turn lane. Although the delay is higher than desired for the entry left turn, it is not uncommon for movements across heavy opposing through volumes. The exiting left turn, with much higher delays and a slightly higher 95th percentile queue could be a greater concern in the future. Much like the access to Dagwood Avenue, the delays and stacking on the exit driveway could be considered an internal concern, to be managed as they see fit (providing two outbound lane with sufficient stacking, scheduling of truck exits away from the peak period, etc.).

Due to the characteristics of the large trucks, mitigation may be more appropriate at this driveway if operational concerns do arise in the future. Potential intersection mitigation to help improve the truck operations at the Lexington Parkway driveway includes signalization as well as rerouting outbound left turn movements. All-way stop, roundabout control, and other alternative intersection designs are not appropriate.

Installation of a traffic signal at this intersection would result in roughly quarter mile spacing between the Lexington Parkway intersections with Dagwood Avenue, the facility truck access, and State Highway GG. This spacing allows for proper traffic signal coordination to optimize vehicle flow, which is recommended if a traffic signal is ultimately installed.

Under standard signal control of all approaches, delays are reduced, and the intersection operates at LOS A. Vehicle queues, both car and truck, remain reasonable.

A modified traffic signal was also reviewed, assuming the northbound through lanes are split. The easternmost lane through movement would continue outside of the traffic signal without stopping. The westernmost lane through movement, and southbound lanes, would be controlled by the traffic signal as normal. This layout allows continual progression of one northbound lane, while still allowing exiting left turning truck traffic to exit the development on a green phase. Slightly improved delays were achieved under this layout with LOS A operation. The two northbound lanes would come together north of the intersection, back to a standard road. A risk with this operation is the splitting of northbound traffic. Stopped vehicles in one lane would be adjacent to high speed vehicles in the next lane. The differences in speed, and an increase in drivers weaving between the two lanes, would result in more sideswipe crashes.

The exiting truck left turn movements from the facility onto Lexington Parkway are expected to operate with the highest delays and queues during the peak periods in the future. Rerouting these trucks would eliminate these issues at the intersection. All exiting trucks at this location would complete a right turn movement onto southbound Lexington Parkway at least during the peak traffic times of Lexington Parkway. To travel north on Lexington Parkway, truck drivers would have to reroute through Westmere Drive or other public corridors in the surrounding network. This rerouting would increase travel distances for the warehouse truck traffic. While clearly not desired from the site's standpoint, rerouting the outbound left turning trucks remains an option, if needed.

7. Parking Evaluation

a. Automobile Parking Forecasting & Analysis

Parking to be Provided On-Site

The proposed warehouse expansion will continue to provide parking by surface lots, expanding the employee parking area. The vehicle parking will increase from 698 spaces today to 879 spaces with the expansion.

Parking Required by City Code

According to the City of Republic's Chapter 405 Zoning Regulations, off-street parking is required. Section 405.570 of the regulations states the site must provide one parking space for every two employees on the maximum working shift. The maximum number of employees expected at one time, per information from the owner, is 736. Per the formula, a minimum of 368 parking spaces are required.

The regulation further states parking space to accommodate all trucks and other vehicles in connection with the development is also required. The proposed expansion includes additional parking for trucks and trailers as well as additional docking bays. These improvements will accommodate all trucks as required.

The proposed parking for the proposed expansion will exceed the minimum City requirements.

Expected Parking Demand

The expected parking demand was evaluated through two methods: using information from the owner and from the Institute of Transportation Engineers' (ITE) *Parking Generation, 4th Edition*. The ITE manual compiled parking demand data from different land uses to forecast peak period parking demands. Those peak period parking demands are summarized in Table 4.

Table 4 – Peak Period Parking Demands

Land Use Code – Source	Description & Size	Peak Parking Demand (Occupied Stalls)		Peak Parking Time	
		Weekday	Saturday	Weekday	Saturday
ITE – 701[1]	Warehouse – Full Occupancy (932,837 SF)	574	N/A*	09:00 – 11:00	N/A*
Local[2]		736	N/A*	09:00 – 11:00	N/A*

[1] Unadjusted parking generation based on ITE's *Parking Generation, 4th Edition*.

[2] Unadjusted parking generation based on employee and delivery information from the owner.

*The warehouse parking demand is expected to be minimal or zero over the weekend.

The proposed parking supply exceeds both the City requirements and the expected demand.

b. Bicycle Parking Forecasting & Analysis

The City does not require bicycle parking and has no bicycle facilities in the area. It is legal for bicyclists to ride in the street with vehicle traffic.

The current site plan does not specify if or where bicycle parking might be located.

Although not required, a few bicyclists are expected among the large workforce necessary for full occupancy of the warehouse facility. For that reason, having ten to 12 bicycle parking spaces with room for expansion is recommended. This small amount will provide initial support to any bicyclists and could then be expanded for more bicyclists as the workforce expands and as surrounding bicycle facilities are constructed.

8. Multi-Modal Evaluation & Site Plan Review

a. Transit Use

As mentioned, transit does not serve this area. When the opportunity arises, it is recommended the City and owner expand regular service transit to this area.

b. Bicycle Use

As discussed in the prior section, the site and surrounding roadway do not provide specific bicycle facilities at this time. Since bicycle travel remains legal on roads and given the size of the workforce with full occupancy of the warehouse, some bicycle travel should be expected. For this reason, providing initial parking with room for future expansion is recommended.

Furthermore, if and when specific bicycle facilities are constructed in the surrounding transportation network, the owner should look for connection opportunities. Providing a thoughtful connection to and from any future bicycle lanes would improve the safety of bicycle travel and encourage its use.

c. Pedestrian Travel

Sidewalks are generally recommended, and may be required, for the collectors and arterial roadways around the proposed expansion site. Sidewalks are currently provided on Dagwood Avenue and the east side (not adjacent to the site) of Lexington Parkway.

The proposed expansion is recommended to expand the sidewalk network on the roads adjacent to the site. A cursory examination of the right-of-way and proposed plans suggest sufficient space for a five-foot sidewalk near the road and outside of the proposed security fencing.

In addition, a proper connection between the sidewalk along Dagwood Avenue and the proposed Customer Service building is recommended. Providing this connection will physically direct visitors to the proper building, improve safety by providing a space outside the parking areas, and encourage walking through the safe design.

d. Site Plan Review

The primary point of discussion with the public agencies revolved around having only one access for all employee and visitor parking. This document presents mitigation options to provide for safe everyday travel through this single access point. The City rightly points out that emergencies or other unforeseen event, not everyday travel, could disrupt those operations.

Through further discussions with the owner and the public agencies, two contingency plans have been developed for potential traffic events, like a crash, that would prevent use of the single employee access for a period of time.

The first option is to create a new driveway connection to the east, eventually intersecting with Lexington Parkway. A parcel of land not under the warehouse ownership exists between the proposed expansion site and Lexington Parkway. A driveway could be extended from the employee parking area through this parcel and to the connection with Lexington Parkway.

Given the volume of traffic on Lexington Parkway and the existence of the center median, this new access driveway would be restricted to right-in/right-out only. Since another parcel of land is impacted, the owner will need assistance from the City in exploring and building this potential connection.

A second option is to provide an internal, gated connection around the proposed customer service/employee entrance with access to the north driveway connection to Westmere Drive. Since this option introduces passenger car traffic to the truck traffic area, as well as a secure area of the site, this connection should be viewed as an emergency access only.

Either option is feasible based on preliminary reviews. The owner is making site plan adjustments to provide for the second option internal gate connections. Although no plans for constructing an access to Lexington Parkway are currently underway, the owner is discussing the first option further with City staff to have the underlining information ready should the option be necessary at some point in the future.

9. Sight Distance Review

As discussed in the Preliminary Assessment, which is provided in the Appendix, a basic sight distance check was completed using the AASHTO time-based methodology for sight distance evaluation. The results for each intersection are provided in Table below.

Table 5 – Sight Distance Checks

Site Driveway	Threshold	Looking to the north or west			Looking to the south or east		
		# of Evals	Lowest	Average	# of Evals	Lowest	Average
So Truck Access to Westmere Dr	9.5[A]	10	18.5	20.6	10	18.1	19.4
No Truck Access to Westmere Dr	9.5[A]	10	11.9	13.3	10	15.9	17.3
Employee Access to Dagwood Ave	7.5	10	20.0	24.3	10	10.1	11.7
Truck Access to Lexington Pkwy	9.5[A]	10	10.0	11.6	10	9.6	10.1

[A] Standard 7.5 seconds plus 2.0 seconds to account for heavy truck traffic.

As shown, the existing driveway accesses provide sufficient sight distance.

10. Conclusions and Recommendations

The traffic impacts of the proposed development were thoroughly studied, and the principal findings are:

- The current warehouse facility is operating at about 30 percent capacity. The associated traffic counts for the site match approximately 30 percent of the expected trip generation from prior studies. Full capacity of the facility is expected to generate 7,190 total trips during an average weekday, 727 trips during the a.m. peak hour and 715 trips during the p.m. peak hour and remains consistent with prior studies.
- Lexington Parkway is currently at the "nearing capacity" level and above the congested planning level capacity under the long-term scenario with or without the full occupation of the facility.
- Dagwood Avenue is projected to operate with volumes within the nearing capacity levels under the short-term and long-term scenarios with the full occupancy of the facility. These levels will increase with further development of the Bradford Road Industrial Area and, as studied previously, will likely require a four-lane roadway in the future. The proposed warehouse expansion contributes to the need for four-lanes, but is not the sole cause of that need.
- No issues arise at any of the study intersection in the a.m. peak hour with all queuing and delays remaining below the acceptable bounds.
- Congestion becomes a concern in the p.m. peak hour with both the Dagwood Avenue/Lexington Parkway and State Highway GG/Lexington Parkway intersections operating at LOS E or worse during the short-term scenario.
- Queuing at the facility access to Dagwood Avenue is a concern in the p.m. peak hour during the existing distribution short-term scenario with northbound right queues at 12 vehicles:
    - These queues magnify under the proposed driveway utilization layout restricting all employees to the Dagwood Avenue access only.
    - These queues only occur to employees on the site property and do not impact the public or public roadways.
    - If/when Dagwood Avenue is expanded to a four-lane facility, the queues and delays are greatly reduced.
- While the northbound left turn truck movement at the Lexington Parkway Driveway are expected to operate at LOS F with longer delays than desired during peak periods, the truck stacking remains reasonable and is expected to stay within its storage lane capacity.
- As volumes on Lexington Parkway and exiting truck volumes from the site continue to increase, the slower truck acceleration and longer vehicle length could become an operational concern:
    - The Westmere Drive extension to State Highway GG will help to reduce these queues as more travel routes are provided for truck movements entering and exiting the site.
    - The delays and queues are primarily an internal issue, similar to the Dagwood Avenue access results.

    - The characteristics of the truck traffic is a differentiating factor compared to the Dagwood Avenue access.
- The proposed parking supply exceeds the City's minimum requirements and the expected demand for the site.
- Bicycle parking is not currently shown on the plan and the surrounding network does not provide specific bicycle facilities. Bicycle travel on roadways in the vehicle lanes is legal.
- Sidewalks are present on Dagwood Avenue and the east side of Lexington Parkway, but not all around the site. Sufficient space is available for sidewalks adjacent to surrounding roads, but outside the proposed security fence.
- Two options are available for secondary access to the proposed employee only parking area, which would alleviate the proposed single access if traffic or other events prevent use of that sole access.
- Sight distance at the existing access driveways exceeds the requirements.

The following recommendations are made based on the above findings:

- Continue to monitor volumes on Dagwood Avenue and Lexington Parkway to determine when expansion to a four-lane and six-lane roadway is required.
- Retime all traffic signals at least every three years to ensure signal timing reflects the changing traffic patterns of the area due to growth and other factors.
- Provide dual left turn lanes for westbound traffic at the State Highway GG and Lexington Parkway intersection.
- Provide dual left turn lanes for eastbound traffic on Lexington Parkway and Dagwood Avenue as well as separate left turn, through, and right turn lanes for the westbound approach.
- Continue to monitor queue lengths at the Lexington Parkway truck access to determine if and when additional traffic control or rerouting of outbound left turn truck traffic during the peak periods is necessary. The use of a full or partial traffic signal, as well as rerouting outbound left turn traffic is acceptable and should be reviewed further when traffic volumes are approaching capacity.
- Provide ten to 12 bicycle parking stalls initially, with area for potential expansion if and when specific bicycle facilities are constructed near the site. Connections to and from any future facilities should also be considered with the parking.
- Remain open to transit opportunities when they arise.
- Construct sidewalks around the site, expanding the public network. A connection between the public sidewalks and the proposed customer service building should also be provided.
- Adjust the site plan for an internal gated access on the west side of the employee parking area to allow for access to the Westmere Drive driveway if needed.
- Continue to explore the feasibility of a connection to the east, providing a right-in/right-out access on Lexington Parkway as a secondary access to the employee parking area.

Based on this study, the prior conclusions and recommendations of previous studies remain valid. Right-of-way for long-term improvements should be reserved when possible to reduce future costs and complications of those improvements.

11. Appendix

A. Preliminary Transportation Assessment

B. Site Plan

C. Traffic Counts

D. Trip Generation Table

E. Capacity Analysis Backup