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TRANSPORTATION IMPACT ANALYSIS

To
City of Tualatin

For
Lam Research

Dated
August 12, 2022

Project Number
2220087.00

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I. INTRODUCTION

This Transportation Impact Analysis (TIA) has been prepared in support of the proposed new office building (Building G) at the Lam Research campus in Tualatin, Oregon. Figure 1 (in Appendix A) presents a vicinity map indicating the project location.

Project Description

An approximately 120,000-square-foot (SF) office building is proposed just north of SW Leveton Drive between the existing Center and East Accesses. Up to 600 office staff are planned to occupy the proposed building. Fewer than 10% of the new office staff will work remotely. Surface parking for approximately 530 spaces is proposed along SW 108th Avenue. The buildout year for the new office building is assumed to be 2024.

The existing East Access on SW Leveton Drive is proposed to be limited to truck access. To accommodate the additional office trips, two (2) new driveways are proposed on SW 108th Avenue with direct access to the expanded parking area. The North Access is proposed to be aligned opposite the north driveway serving Olympic Controls. The South Access is proposed approximately 445 feet south of the North Access.

Scope of Analysis

This TIA has been prepared in accordance with the *City of Tualatin Traffic Study Requirements* (updated March 16, 2022), Tualatin Development Code (TDC) Section 74.440, and the Oregon Department of Transportation's (ODOT) *Analysis Procedures Manual* (APM) Version 2. This study includes a summary of existing traffic conditions, crash review, proposed trip generation, and an analysis of intersection operations, sight distance, queuing, and signal and turn-lane warrants.

A TIS scoping letter dated June 30, 2022 was submitted to City staff and approved in a July 15, 2022 email. An additional study area intersection was requested in an August 2, 2022 email. The scoping letter and corresponding communications are provided in Appendix B for reference.

Study Area

The City's *Traffic Study Requirements* document requires all intersections within a 1/4-mile radius of the project site be included as part of the study area. Washington County requires analysis for all intersections where project trips will exceed 10% of the existing average daily traffic (ADT). No Washington County intersections were found to meet this threshold. The following intersections are located within the 1/4-mile radius and were included in the study area:

1. Pacific Highway W (OR-99W)/SW 124th Avenue
2. SW Tualatin Road/SW 124th Avenue
3. SW Tualatin Road/SW 108th Avenue
4. SW 108th Avenue/North Access
5. SW 108th Avenue/South Access
6. SW Leveton Drive/SW 124th Avenue
7. SW Leveton Drive/SW 118th Avenue
8. SW Leveton Drive/West Access
9. SW Leveton Drive/Center Access
10. SW Leveton Drive/East Access

11. SW Leveton Drive/SW 108th Avenue
12. SW Herman Road/SW 108th Avenue
13. SW Tualatin Road/SW Teton Avenue

All study area intersections are located within City of Tualatin jurisdiction. The OR 99W/SW 124th Avenue intersection is located on an ODOT facility.

Analysis Scenarios

This TIS addresses AM and PM peak hour conditions for the following analysis scenarios:

- 2022 Seasonally Adjusted
- 2024 Pre-Development without proposed Office
- 2024 Post-Development with proposed Office

II. EXISTING CONDITIONS

The existing conditions analysis is based on a current year 2022 inventory of transportation facilities and traffic data.

Site Conditions

The project site is in Tualatin, Oregon within the Portland metropolitan area. The site is approximately 58.01 acres and consist of tax lots 100 of Washington County tax map 2S1 22AB, and tax lots 500 and 800 of tax map 2S1 22AA. The site is part of the City's Manufacturing Park (MP) Planning District. The Novellus Industrial Master Plan (IMP) was approved in 2001 as a four-phase development consisting of 1,440,000 SF. The proposed office building is considered to be the last building of the IMP's Phase 1. The proposed site plan is presented in Figure 2.

Vehicular Transportation Facilities

Figure 3 presents existing lane configurations and traffic control devices for all study area intersections. Table 1 below summarizes roadway characteristics within the study area.

TABLE 1 – ROADWAY CHARACTERISTICS

Roadway	Functional Classification	Posted Speed	Travel Lanes	Bike Lanes	On-Street Parking	Sidewalks
OR 99W (Pacific Highway W)	Major Arterial/ (Urban Principal Arterial)	45/55 mph	4	Yes	None	Intermittent
SW 124th Avenue	Major Arterial	45 mph	4/5	Yes	None	Yes
SW Tualatin Road	Major Collector	35 mph	3	Yes	None	Yes
SW Leveton Drive	Minor Arterial	35 mph	2	Yes	None	Yes
SW 108th Avenue	Minor Collector (north of SW Leveton Drive)	35 mph	2	Yes	None	Yes
SW Herman Road	Minor Arterial	35 mph	2	Yes	None	Yes
SW Teton Avenue	Minor Arterial	35 mph	2	Yes	None	Yes

Pedestrian and Bicycle Facilities

The study area has nearly complete bicycle and pedestrian networks. Clearly marked bike lanes are provided on all study area roadways. Curb-tight sidewalks are provided on SW 108th Avenue and SW Tualatin Road, as well as some segments of the north side of SW Herman Road. Separated sidewalks are provided on all other study roadways and segments.

Transit Facilities

The study area is served by TriMet Bus Lines 94 and 97 with stops on Pacific Highway W (OR 99W) and SW Tualatin Road. The Tualatin Shuttle also has a stop on SW Leveton Drive just south of the site. Transit maps and bus schedules are provided in Appendix C for reference.

Existing Traffic Counts

Existing turning movement counts were collected on Thursday, June 9, 2022, during the AM and PM peak periods.

Historical traffic counts from Tuesday, May 11, 2021 for the SW Tualatin Road/SW Teton Avenue intersection were utilized as this intersection was requested for analysis by City staff while school was not in session. An adjustment of 1.30 was applied to the AM peak hour counts and an adjustment of 1.05 was applied to the PM peak hour counts at this location to reflect the growth from 2021 to 2022.

Figure 4 presents the existing AM and PM peak hour traffic volumes. Raw traffic count summaries are provided in Appendix D.

Seasonal Adjustment

Pacific Highway W (OR 99W) is a state facility which requires a seasonal adjustment as specified in the APM. There is no seasonal adjustment data available for this location as there is no nearby Automatic Traffic Recorder (ATR). Therefore, a seasonal adjustment of 1.01 derived from data presented in ODOT's 2020 Seasonal Trend Table for the "Commuter" trend was applied to 2022 existing through volumes on OR 99W. The 2020 Seasonal Trend Table relies on pre-COVID 2019 volumes and is therefore the best available data for 2022 traffic. The 2022 seasonally adjusted traffic volumes are presented in Figure 5. The seasonal adjustment calculation is provided in Appendix E for reference.

Adjustment for Telecommuting

Existing traffic counts collected on Thursday, June 9, 2022 reflect a portion of Lam office staff telecommuting. While a review of historical and existing traffic counts on I-5 just north of the Nyberg Street exit shows that existing traffic in the greater Tualatin area may be comparable to pre-COVID traffic, existing counts adjacent to the Lam site are lower due to some staff currently telecommuting.

Lam Research does not currently have a permanent hybrid work plan. Therefore, we propose to growth adjust existing traffic counts to match 100% on-site attendance by applying an adjustment factor of 1.92 in the AM peak hour and 1.28 in the PM peak hour to site trips. These adjustments were based on the actual 2018 and 2022 turning movement volumes at the site driveways. The AM peak adjustment is higher than the PM peak adjustment, likely due to office staff entering the site later in the day, outside the morning peak between 7 AM and 9 AM, while continuing to exit the site during the afternoon peak between 4 PM and 6 PM. These modified site trips were carried through the adjacent roadway network as needed, similar to in-process trips, to estimate traffic volumes without the current remote work scenario.

TABLE 2 – TRAFFIC ADJUSTMENT FOR TELECOMMUTING					
AM Peak Hour Site Trips			PM Peak Hour Site Trips		
2018 Historical	2022 Existing	Adjustment Factor	2018 Historical	2022 Existing	Adjustment Factor
Entering – 422 Exiting – 26 Total – 448	Entering – 221 Exiting – 50 Total – 271	1.92 (Entering Only)	Entering – 168 Exiting – 445 Total – 613	Entering – 149 Exiting – 349 Total – 498	1.28

Figure 6 presents the additional 2022 site trips for remote workers during the AM and PM peak hours.

SW 108th Avenue Driveways

This TIA reviews the impact the proposed driveways on SW 108th Avenue will have on existing, nearby driveways. In order to estimate the possible queues along SW 108th Avenue, the trips generated by the existing Olympus Controls building were estimated using the Institute of Transportation Engineers' (ITE) *Trip Generation Manual,* 11th Edition data for a "Warehouse" use (LUC 150). The proposed North Access will be aligned opposite the northern access serving Olympus Controls. The proposed South Access will be spaced approximately 130 feet north of the southern access serving Ascentec Engineering. The Olympus Controls building is estimated to generate 33 AM and 35 PM peak hour trips. These trip generation estimates and the existing traffic counts were used to estimate the volumes at the Olympus Controls driveways. Existing peak hour counts for the southern Ascentec Engineering access were collected and are provided in Appendix D.

Crash Analysis

Historical crash data reported for the study area intersections were evaluated to identify patterns that might indicate a safety concern. Crash data for the 5-year period of 2016 through 2020 were obtained from ODOT's online crash data system and used to review crash patterns and estimate intersection crash rates.

The crash evaluation is summarized in Table 3. The raw crash data are provided in Appendix F.

TABLE 3 – INTERSECTION CRASH RATES								
Intersection (Traffic Control Type)	Year					Total Crashes	ADT	Crash Rate
	2016	2017	2018	2019	2020			
Pacific Highway W/ SW 124th Avenue (Signalized)	7	6	7	7	2	29	49,000	0.32
SW Tualatin Road/ SW 124th Avenue (Signalized)	2	3	1	3	1	10	25,800	0.21
SW Tualatin Road/ SW 108th Avenue (TWSC)	2	0	0	0	1	3	13,100	0.13

TABLE 3 – INTERSECTION CRASH RATES								
Intersection (Traffic Control Type)	Year					Total Crashes	ADT	Crash Rate
	2016	2017	2018	2019	2020			
SW Leveton Drive/ SW 124th Avenue (Signalized)	0	2	1	4	1	8	17,500	0.25
SW Leveton Drive/ SW 118th Avenue (AWSC)	0	0	0	0	0	0	4,900	0.00
SW Leveton Drive/ SW 108th Avenue (TWSC)	1	2	0	0	0	3	3,100	0.53
SW Herman Road/ SW 108th Avenue (Signalized)	1	0	0	0	1	2	11,200	0.10
SW Tualatin Road/ SW Teton Avenue (TWSC)	1	1	1	2	0	5	14,600	0.19

Crash Data Summary

During the five-year study period, there were 29 collisions reported at the intersection of Pacific Highway W (OR 99W) and SW 124th Avenue. 21 of these were rear-end collisions, the majority of these being in the northbound through direction. Five (5) of the other crashes were turning movement collisions. These collisions were reported to be caused by drivers failing to avoid the vehicle ahead or improper turns and other improper driving. The remainder of crashes include two (2) angle collisions and one (1) fixed object collision. All of these collisions were reported to cause property damage (12 collisions) or minor injuries (15 collisions), with two (2) Injury B type crashes in 2016 and 2020.

Ten (10) collisions were reported at the intersection of SW Tualatin Road and SW 124h Avenue. Six (6) of these were turning movement collisions caused by a failure to yield by drivers completing the southbound left-turn movement. This may be the result of drivers running red lights due to a high turn volume and a short green phase. Five (5) of these collisions caused possible injuries (Injury Type C). There was one collision involving a pedestrian; a driver completing a westbound right turn failed to yield to a pedestrian in the crosswalk at the intersection. The other reported crashes were rear-end and fixed-object type collisions, mostly in the westbound direction.

At the intersection of SW Tualatin Road and SW 108th Avenue, all three (3) reported crashes were turning movement collisions caused by drivers failing to yield or drivers disregarding a traffic control device, and mostly by drivers completing the northbound left-turn movement. Again, this may be due to drivers running red lights due to a high turn volume and short green phase.

At the intersection of SW Leveton Drive and SW 124th Avenue, there were eight (8) reported crashes, five (5) of which were rear-end collisions. Four (4) of these crashes caused injuries of Type B or C. Six (6) of these collisions occurred in the southbound direction. Rear-end collisions are typical at signalized locations where drivers may stop abruptly at the onset of a yellow light.

At the intersection of SW Leveton Drive and SW 108th Avenue, there were three (3) reported crashes in the past five (5) years. Two (2) were turning movement collisions and the other one (1) was a rear-end collision. All three crashes occurred in the eastbound and westbound directions, and were caused by inattention or failure to yield.

During the study period, there have been two (2) rear-end collisions at the SW Herman Road/SW 108th Avenue intersection. These occurred in the eastbound and westbound directions, and were caused by inattention.

At the intersection of SW Tualatin Road and SW Teton Avenue, there have been five (5) reported crashes in the last five (5) years. Three (3) of these collisions were turning movement collisions for the northbound left-turn movement, caused by a failure to yield. This is likely due to drivers taking shorter gaps in traffic due to heavy through volumes on SW Tualatin Road. All of the crashes which occurred in the northbound left turn caused "property damage only" and no injury. The other two (2) collisions were one (1) rear-end in the northbound movement and one (1) fixed-object collision.

Overall, there were no fatalities or serious injury crashes reported in the least five (5) years at any study area intersections. There appear to be no safety deficiencies at any study area intersections that contribute to the historical crashes reviewed.

Intersection Crash Rates

Intersection crash rates were calculated as a measure of the number of crashes occurring per one million entering vehicles (MEV) per year. The intersection crash rate is calculated by dividing the average number of crashes per year by the MEV per year. An average daily traffic (ADT) volume was estimated by dividing the PM peak hour volume at each intersection by a peak-to-daily factor, or k-factor, of 0.09 obtained from ODOT's 2020 traffic flow data on OR 99W just west of SW 124th Avenue.

All intersections have crash rates below 1.0 MEV. Therefore, no further analysis is recommended.

III. PRE-DEVELOPMENT CONDITIONS

The pre-development conditions reflect build-out year conditions without the proposed development. This scenario includes existing year 2022 traffic volumes, a seasonal adjustment to traffic on OR 99W, a growth adjustment factor to account for telecommuting staff, background growth to year 2024, and in-process trips from nearby approved developments. The pre-development traffic without project trips will indicate if traffic issues are present before the addition of the proposed development.

Planned Transportation Improvements

The City of Tualatin Capital Improvement Plan 2021-2025 (CIP) was reviewed for any planned transportation improvements in the area that may affect capacity. The City plans to add a northbound turn lane at the SW Herman Road/SW 118th Avenue intersection. While this improvement is near the development site, it does not impact future capacity or trip routing for any study area intersections in this report.

Background Traffic Growth

Background traffic growth was applied to adjusted year 2022 traffic volumes to forecast future traffic demand. A linear 1% annual growth rate over two (2) years was applied to year 2022 traffic volumes to estimate 2024 background traffic volumes. This growth adjustment was based on ODOT traffic volume projections for OR 99W just south of SW 124th Avenue between years 2019 and 2040. Background growth was applied to all movements at all intersections, except driveways. Figure 7 presents the background growth from 2022 to 2024 for the AM and PM peak hours.

In-Process Traffic

In-process traffic volumes account for developments that have been approved or that are under construction at the time of a traffic study. These traffic volumes account for traffic that will be added to the external roadway network before buildout of the proposed development. Traffic volumes for the following developments were included as in-process:

- Tualatin Logistics Park
- Lu Pacific Development (Herman Road Industrial)
- Hedges Creek Industrial

Four (4) access scenarios were provided in the TIA prepared for the Tualatin Logistics Park project. The in-process trips included in this TIA reflect the volumes provided in Scenario 2, which is consistent with the approved access configuration. Figure 8 presents the in-process trips during the AM and PM peak hours.

Pre-Development Traffic

The 2024 pre-development analysis scenario is a combination of existing year 2022 traffic volumes, a seasonal adjustment factor on OR 99W, a growth adjustment factor to account for telecommuting staff, background growth of 1% over two (2) years, and in-process trips from nearby approved developments. Figure 9 presents the 2024 pre-development traffic volumes during the AM and PM peak hours.

IV. SITE DEVELOPMENT

The trip-making characteristics of the proposed development are described below.

Trip Generation

The proposed 120,000 SF office building will provide space for office staff generally working between 8 AM and 5 PM. Up to 600 employees will be added to the campus with the new office building. Most new office staff are anticipated to work from the office in the future. Trip generation estimates were developed with the use of the Institute of Transportation Engineers' (ITE) *Trip Generation Manual,* 11th Edition. The City requires the reasonable worst case for trip generation be analyzed. Therefore, trip rates for ITE's "General Office Building" (LUC 710) using building area were utilized in this study.

Table 4 presents the trip generation estimates for the proposed office building.

TABLE 4 – TRIP GENERATION

ITE Code	ITE Land Use	Size	Trip Type	AM Peak Hour			PM Peak Hour			Daily
				In	Out	Total	In	Out	Total	
710	General Office Building	120.0 KSF	Total	172	24	196	33	160	193	1,360

Trip Distribution and Assignment

Trip distribution for the proposed office building was estimated by reviewing the existing distribution from recent and existing counts at the site driveways in conjunction with review of previous trip distribution assumptions for the Lam Research campus. The following trip distribution was assumed:

- 15% to/from the south on Highway 99W
- 25% to/from the north on Highway 99W
- 5% to/from the east on SW Tualatin Road
- 15% to/from the south on SW 124th Avenue
- 5% to/from the south on SW 118th Avenue
- 35% to/from the east on SW Herman Road

Figure 10 presents the trip distribution and traffic assignment for the AM and PM peak hours.

East Access Reroutes

With the proposed building, other site changes including additional parking along SW 108th Avenue, two (2) new driveways on SW 108th Avenue, and limiting the East Access on SW Leveton Drive to trucks are proposed. With the closure of the East Access to passenger vehicle traffic, existing site trips that currently utilize this driveway are anticipated to reroute to the proposed driveways on SW 108th Avenue to access the expanded parking area. Figure 11 presents the East Access trip reroutes for the AM and PM peak hours.

Post-Development Traffic

Post-Development traffic volumes are the sum of the project trips and the pre-development traffic volumes. Figure 12 presents the 2024 post-development traffic volumes for the AM and PM peak hours.

V. SITE ACCESS AND CIRCULATION

The on-site evaluation of traffic access and circulation and a review of sight distance at the existing site driveways are presented below.

Site Access

The proposed development will have access to two (2) existing, full-movement driveways on SW Leveton Drive and two (2) proposed, full-movement driveways on SW 108th Avenue. The third driveway on SW Leveton Drive will be limited to trucks and will become directional (inbound or outbound only).

Access Standards

The TDC includes several sections related to access standards. Chapter 75 of the TDC presents access standards relative to driveway widths and spacing on the site. Per Table 75-1 of the TDC, minimum driveway approach width for industrial driveways is 36 feet and the maximum is 40 feet for driveways providing access for over 250 parking spaces. The existing driveways for the site meet these standards. The proposed driveways on SW 108th Avenue will meet these standards at a proposed width of 36 feet.

Per TDC 75.120, driveways on Minor Collectors must be spaced a minimum of 100 feet. Driveways must be located at least 150 feet from the intersection of Collector or Arterial streets, as measured from the stop bar, per TDC 75.040(11)(a). Additionally, driveways must provide a minimum distance of 40 feet between on-site driveways per TDC 75.040(10).

TABLE 5 – ACCESS SPACING SUMMARY

Access	Roadway	Functional Classification	Spacing Standard	Access Spacing Measured Edge-to-Edge	
				To North	To South
North Access	SW 108th Avenue	Minor Collector	150' to Arterial or Collector intersections/ 100' between driveways	635 feet	445 feet
South Access				445 feet	150 feet

The proposed site driveways on SW 108th Avenue will meet the City's access spacing standards as summarized in Table 5.

On-Site Circulation

The site currently provides access to staff via three full-movement driveways on SW Leveton Drive. A fire access is provided on SW Tualatin Road opposite SW 115th Avenue and a construction access is provided on SW 108th Avenue approximately 300 feet south of SW Tualatin Road. Both of these driveways are gated.

With the proposed office building, the East Access on SW Leveton Drive will be limited to truck use. Two (2) new full-movement driveways are proposed on SW 108th Avenue. The North Access will be provided opposite the northern access to Olympus Controls. The South Access will be provided approximately 445 feet south of the North Access. Trucks will navigate to the new office building by entering the East Access on SW Leveton Drive and exiting the proposed South Access on SW 108th Avenue. All new office staff are

anticipated to access the site via the two (2) proposed driveways on SW 108th Avenue where an additional approximately 500 new parking spaces will be provided.

Sight Distance Evaluation

Intersection sight distance was evaluated for the proposed site driveway locations. The American Association of State Highway and Transportation Officials' (AASHTO) *A Policy on Geometric Design of Highways and Streets,* 7th Edition provides recommendations for intersection sight distance (ISD) based on roadway design speed. At minimum, stopping sight distance (SSD), also based on roadway design speed, must be provided.

A time gap of 7.5 seconds and 11.5 seconds were assumed for passenger vehicles and combination trucks completing a left turn from stop, respectively. SW 108th Avenue is relatively flat. Therefore, no grade adjustments were made for the ISD and SSD calculations. There is no posted speed on SW 108th Avenue north of SW Herman Road. Therefore, the design speed on SW 108th Avenue was assumed to be 5 mph over the posted speed of 35 mph for other Minor Collectors in the area, or 40 mph. The recommendations for ISD have been noted for left turns from stop on a stop-controlled minor approach (driveway). The sight distance evaluation for the site driveways is presented in Table 6.

TABLE 6 – SIGHT DISTANCE EVALUATION

Access/ Intersection	Design Speed (mph)	Design Vehicle	Recommended Intersection Sight Distance (feet)	Required Stopping Sight Distance (feet)	Available Sight Distance (feet)	
					To North	To South
SW 108th Avenue/ North Access	40	Passenger	445	305	430	>500
SW 108th Avenue/ South Access	40	Passenger	445	305	>700	>700
		Combination Truck	680			

As presented in Table 6, the recommended ISD is available to the south from both proposed driveway locations, as well as to the north from the South Access for both passenger vehicles and combination trucks. From the proposed North Access location, there is a vertical crest to the north on SW 108th Avenue that precludes meeting the recommended ISD by 15 feet. However, both proposed site driveway locations are projected to meet the SSD requirement in both directions along SW 108th Avenue.

VI. OPERATIONAL ANALYSIS

Two aspects of operational analysis were evaluated for the study area intersections: 1) intersection operations analysis, which evaluates how well an intersection processes traffic demand, and 2) queuing analysis, which compares intersection queues with available storage for different travel lanes.

Intersection Operation Analysis

Intersection operations are generally measured by three (3) mobility standards: volume-to-capacity (v/c) ratio, level-of-service (LOS), and delay (measured in seconds). Signalized and all-way, stop-controlled (AWSC) intersections are measured by one (1) overall v/c ratio, LOS, and delay. Two-way, stop-controlled (TWSC) intersections are typically measured by a single v/c ratio, LOS, and delay representative of the worst stopped movement.

Performance Measures

All study area intersections are located within City of Tualatin jurisdiction but OR 99W is under ODOT's jurisdiction.

City of Tualatin

The TDC Section 74.440(3)(e) requires the following mobility standards for intersections within City jurisdiction:

- LOS D or better for signalized intersections
- LOS E or better for unsignalized intersections

ODOT

The *Oregon Highway Plan* (OHP) designates OR 99W as a Principal Arterial Route at SW 124th Avenue. Table 7 of the OHP establishes a v/c target of 0.99 for the OR 99W/SW 124th Avenue intersection.

Methodology

Intersection operations were analyzed with the use of Synchro 11 software, which utilizes the Transportation Research Board's *Highway Capacity Manual* (HCM) 2000, HCM 2010, and HCM 6 methodologies. Signalized study area intersections were reported using HCM 2000 reports for overall v/c ratio and HCM 6 reports for delay and LOS. Two-way, stop-controlled (TWSC) and AWSC intersections were reported using HCM 6 reports. Signal timing plans were obtained from the Washington County traffic plans database, as well as from ODOT staff, and are provided in Appendix H for reference.

Findings

The operations results for the intersection or critical movement at each study area intersection are presented in Table 7. The detailed Synchro capacity results are provided in Appendix I for reference.

TABLE 7 – PEAK HOUR INTERSECTION OPERATIONS				
Intersection (Control)	Peak Hour	Analysis Results (v/c-LOS-Delay in seconds)		
		2022 Existing	2024 Pre-Development	2024 Post-Development
Pacific Highway (OR-99)/SW 124th Avenue (Signalized)	AM	0.76-C-33.9	0.80-D-38.4	0.80-D-40.3
	PM	0.79-D-36.4	0.84-D-39.6	0.86-D-41.3
SW Tualatin Road/ SW 124th Avenue (Signalized)	AM	0.65-B-10.4	0.68-B-10.8	0.69-B-11.1
	PM	0.51-B-12.8	0.56-B-14.6	0.58-B-15.9
SW Tualatin Road/ SW 108th Avenue (TWSC)	AM	0.10-C-22.8 (NB)	0.11-C-24.7 (NB)	0.13-D-25.8 (NB)
	PM	0.24-C-24.6 (NB)	0.31-D-27.2 (NB)	0.37-D-29.1 (NB)
SW 108th Avenue/ North Access (TWSC)	AM	N/A	N/A	0.01-B-13.3 (EBL)
	PM	N/A	N/A	0.17-A-9.4 (EBL)
SW 108th Avenue/ South Access (TWSC)	AM	N/A	N/A	0.00-B-11.6 (EBL)
	PM	N/A	N/A	0.02-B-10.2 (EB)
SW 124th Avenue/ SW Leveton Drive (Signalized)	AM	0.36-B-10.4	0.40-B-10.8	0.42-B-11.6
	PM	0.32-B-14.4	0.37-B-15.4	0.40-B-16.4
SW Leveton Drive/ SW 118th Avenue (AWSC)	AM	0.28-A-8.5 (EB)	0.42-A-9.9 (EB)	0.54-B-11.8 (EB)
	PM	0.32-A-9.1 (WB)	0.40-A-10.0 (WB)	0.52-B-11.8 (WB)
SW Leveton Drive/ West Access (TWSC)	AM	0.03-B-12.0 (SBL)	0.04-C-15.8 (SBL)	0.05-C-18.3 (SBL)
	PM	0.14-B-11.8 (SBL)	0.20-B-13.3 (SBL)	0.23-C-15.2 (SBL)
SW Leveton Drive/ Center Access (TWSC)	AM	0.01-B-10.1 (SBL)	0.02-B-11.4 (SBL)	0.02-B-12.9 (SBL)
	PM	0.05-B-10.5 (SBL)	0.07-B-11.1 (SBL)	0.08-B-12.3 (SBL)
SW Leveton Drive/ East Access (TWSC)	AM	0.01-A-9.8 (SB)	0.01-B-10.8 (SB)	N/A
	PM	0.11-B-10.4 (SB)	0.15-B-11.1 (SB)	N/A
SW Leveton Drive/ SW 108th Avenue (TWSC)	AM	0.08-A-7.6 (NBL)	0.14-A-7.8 (NBL)	0.44-C-17.5 (EB)
	PM	0.18-A-9.5 (EB)	0.24-B-10.0 (EB)	0.27-B-11.8 (EB)
SW Herman Road/ SW 108th Avenue (Signalized)	AM	0.43-A-6.3	0.50-A-6.6	0.55-A-7.3
	PM	0.55-B-11.2	0.60-B-12.6	0.64-B-14.6

TABLE 7 – PEAK HOUR INTERSECTION OPERATIONS				
Intersection (Control)	Peak Hour	Analysis Results (v/c-LOS-Delay in seconds)		
		2022 Existing	2024 Pre-Development	2024 Post-Development
SW Tualatin Road/ SW Teton Avenue	AM	0.32-D-25.8 (NBL)	0.35-D-27.7 (NBL)	0.35-D-28.3 (NBL)
	PM	**0.96-F-99.1 (NBL, Synchro)** LOS E-26.5 (NBL, SimTraffic)	**1.03-F-122.6 (NBL, Synchro)** LOS E-29.9 (NBL, SimTraffic)	**1.05-F-128.2 (NBL, Synchro)** LOS E-38.5 (NBL, SimTraffic)

The East Access on SW Leveton Drive will be restricted to truck use, which will primarily occur outside the typical peak of the street. Therefore, site operations are listed as "N/A" under post-development conditions.

As presented in Table 7, all study area intersections currently meet the City's mobility standards except the SW Tualatin Road/SW Teton Avenue intersection. The northbound left-turn movement currently operates at an LOS F during the PM peak hour and is projected to continue to fail in the future, per the Synchro analysis results. All other study intersections are projected to continue meeting standards with the proposed office building.

The estimated delay provided by Synchro software at the intersection of SW Tualatin Road/SW Teton Avenue appears to provide a conservative estimate of approximately 99 seconds for the northbound left-turn movement during the PM peak hour; however, a review of PM peak hour traffic at the intersection shows an observed delay of approximately 14 seconds. Additionally, the delay reported by SimTraffic software for this movement was approximately 27 seconds under existing conditions. The delay reported by SimTraffic appears to more accurately reflect actual conditions in the field. This may be because drivers completing the northbound left-turn movement at this intersection are taking shorter gaps due to the high volume on SW Tualatin Road than the gaps assumed in Synchro software. Therefore, we estimate this northbound left-turn movement will operate at an LOS E (corresponding with a 40-second delay) under 2024 post-development conditions, as reported by SimTraffic software.

Intersection Queuing Analysis

An intersection queuing analysis was conducted for the study area intersections for both the AM and PM peak hours to evaluate any potential queue spillbacks.

Methodology

The 95th percentile queues during the AM and PM peak hours were estimated using Synchro and SimTraffic software. Queue demand results were rounded to the nearest 25 feet to represent average vehicle lengths. Because queues are based on an average of five (5) traffic simulations using random arrivals, some fluctuation in results can be anticipated, particularly for movements that are near or over-capacity.

Available queue lengths were estimated using Google Earth Pro software and rounded to the nearest 5 feet. For turn lanes, two (2) available storage values are stated: the first represents the striped storage and the second is the effective storage, or the length physically available regardless of striping, such as a center turn lane upstream of a striped left-turn lane at an intersection. Although travel lanes have no storage defined by striping, two (2) values are reported for through travel lane storage at signalized locations: the first is the distance to an upstream driveway; the second is the distance to an upstream public street intersection.

Findings

The 95th percentile queues obtained from SimTraffic for the AM and PM peak hours are presented in Table 8. The detailed SimTraffic reports are provided in Appendix J for reference.

TABLE 8 – 95TH PERCENTILE QUEUING ANALYSIS

Intersection (Control)	Approach/ Movement	Striped/ Effective Storage (Feet)	AM/PM Peak Hour Queue (feet)		
			2022 Existing	2024 Pre-Development	2024 Post-Development
Highway 99W/ SW 124th Avenue (Signalized)	WBL	315/475	100/350	125/450	125/450
	WBL	315/475	125/350	125/475	125/475
	WBR	295/330	150/300	150/**400**	150/**425**
	WBR	295/315	150/250	150/**325**	150/**350**
	NBT	500	525/400	500/450	**600**/425
	NBT	500	500/375	475/425	**675**/400
	NBR	225/250	**375**/150	**400**/175	**450**/175
	SBL	550/770	500/350	700/400	**800**/400
	SBL	550/690	400/325	700/375	**800**/350
	SBT	50/>1,000	175/275	175/275	750/275
	SBT	50/>1,000	175/275	150/300	700/300
SW 124th Avenue/ SW Tualatin Road (Signalized)	WBL	310/350	100/50	100/150	100/75
	WBR	285/500	75/250	75/400	75/325
	NBT	995	100/200	100/250	100/250
	NBT	995	150/275	200/375	175/450
	NBR	145/230	50/75	50/150	50/150
	SBL	200/300	300/300	300/**325**	300/**325**
	SBT	450	200/75	175/75	200/100
	SBT	450	150/100	175/75	150/100

TABLE 8 – 95TH PERCENTILE QUEUING ANALYSIS					
Intersection (Control)	Approach/ Movement	Striped/ Effective Storage (Feet)	AM/PM Peak Hour Queue (feet)		
			2022 Existing	2024 Pre-Development	2024 Post-Development
SW Tualatin Road/ SW 108th Avenue (TWSC)	WBL	140	50/25	50/25	50/25
	NB	330	50/50	50/75	50/75
SW 108th Avenue/ North Access (TWSC)	EBL	60	N/A	N/A	25/50
	EBR	60	N/A	N/A	50/**75**
	NB	190/620	N/A	N/A	50/25
	SB	160/630	N/A	N/A	25/25
SW 108th Avenue/ South Access (TWSC)	EBL	60	N/A	N/A	25/25
	EBR	60	N/A	N/A	25/50
	NB	110/200	N/A	N/A	25/25
	SB	100/>1,000	N/A	N/A	25/25
SW 124th Avenue/ SW Leveton Drive (Signalized)	EBL	100/130	25/50	25/50	25/50
	EBT+R	270/580	75/75	75/75	75/75
	WBL	145/185	50/50	50/75	50/100
	WBT+R	490/>1,000	25/100	25/125	50/125
	NBL	155/230	50/50	50/50	50/50
	NBT	>1,000	75/125	75/125	75/125
	NBT+R	>1,000	125/175	175/200	175/225
	SBL	165/245	75/50	100/75	125/75
	SBT	>1,000	125/125	150/150	150/125
	SBT+R	995	150/150	175/175	175/175
SW Leveton Drive/ SW 118th Avenue (AWSC)	EB	240/>1,000	75/50	75/50	100/75
	WB	+1,000	50/75	50/75	50/75
	NB	525/>1,000	50/25	50/50	50/50
	SB	650	25/25	25/50	25/50
SW Leveton Drive/ West Access (TWSC)	EB	>1,000	25/50	50/50	50/50
	SBL	135	50/50	50/50	50/75
	SBR	135	50/75	50/75	50/100

TABLE 8 – 95TH PERCENTILE QUEUING ANALYSIS					
Intersection (Control)	Approach/ Movement	Striped/ Effective Storage (Feet)	AM/PM Peak Hour Queue (feet)		
			2022 Existing	2024 Pre-Development	2024 Post-Development
SW Leveton Drive/ Center Access (TWSC)	EB	890	25/25	25/25	25/25
	SBL	125	25/50	25/50	25/50
	SBR	125	25/50	25/50	25/50
SW Leveton Drive/ East Access (TWSC)	EB	400	25/25	25/25	N/A
	WB	550	25/25	25/25	25/25
	NB	25	25/50	25/50	25/50
	SB	105	25/50	25/75	N/A
SW Leveton Drive/ SW 108th Avenue (TWSC)	EB	270	50/50	50/50	100/75
	NB	100	25/25	50/25	50/50
SW Herman Road/ SW 108th Avenue (Signalized)	EBL	100/390	25/25	25/25	50/25
	EB	>1,000	100/100	100/100	125/125
	WB	350	125/175	125/200	175/225
	SBL	135/165	50/100	50/100	75/125
	SBR	115/790	25/25	25/25	25/25
SW Tualatin Road/ SW Teton Avenue (Unsignalized)	WBL	260	50/25	50/25	75/50
	NBL	95/170	75/**175**	75/**175**	75/**225**
	NBR	30/>1,000	75/50	75/50	75/50

As presented in Table 8, queues are projected to be accommodated within existing storage areas at most intersections. The OR 99W/SW124th Avenue, SW 124th Avenue/SW Tualatin Road, and SW Tualatin Road/SW Teton Avenue intersections are projected to have queues that exceed the available queue storage areas under 2024 post-development conditions. This is expected to occur during the peak 15-minute periods of the AM and PM peak hours. For the remainder of the peak hours, queues are mostly projected to be accommodated under existing storage areas, as presented in Table 9.

TABLE 9 – 95TH PERCENTILE QUEUING ANALYSIS (PEAK HOUR)				
Intersection (Control)	Approach/ Movement	Striped/ Effective Storage (Feet)	AM/PM Peak Hour Queue (feet)	
			2024 Post-Development (PHF=Varies)	2024 Post-Development (PHF=1.0)
Highway 99W/ SW 124th Avenue (Signalized)	WBL	315/475	125/450	100/425
	WBL	315/475	125/475	125/450
	WBR	295/330	150/**425**	150/**400**
	WBR	295/315	150/**350**	150/**325**
	NBT	500	**600**/425	500/425
	NBT	500	**675**/400	475/400
	NBR	225/250	**450**/175	**400**/150
	SBL	550/770	**800**/400	750/400
	SBL	550/690	**800**/350	325/350
	SBT	50/>1,000	750/275	275/300
	SBT	50/>1,000	700/300	250/300
SW 124th Avenue/ SW Tualatin Road (Signalized)	WBL	310/350	100/75	100/50
	WBR	285/500	75/325	75/325
	NBT	995	100/250	100/250
	NBT	995	175/450	150/425
	NBR	145/230	50/150	50/150
	SBL	200/300	300/**325**	275/**325**
	SBT	450	200/100	150/125
	SBT	450	150/100	150/125
SW Tualatin Road/ SW Teton Avenue (Unsignalized)	WBL	260	75/50	50/25
	NBL	95/170	75/**225**	75/125
	NBR	30/>1,000	75/50	75/50

As presented in Table 9, the queues for the northbound left-turn movement at the SW Tualatin Road/SW Teton Avenue are projected to be accommodated within the existing storage area for the remainder of the PM peak hour. At the SW 124th Avenue/SW Tualatin Road intersection, the queues for the southbound left-turn movement during the PM peak hour are projected to exceed the available storage length for the remainder of the PM peak hour; however, this queue is not worsened by the addition of new Lam office trips. At the OR 99W/SW 124th Avenue intersection the queues for the southbound left-turn lanes are projected to be accommodated within the existing storage area during the remainder of the PM peak hour.

VII. WARRANTS

The 2001 Novellus IMP approval identified that potential improvements may be needed at the SW Leveton Drive/SW 108th Avenue intersection and along SW 108th Avenue (left-turn lanes) with future development of the site. Therefore, traffic signal and turn-lane warrants were reviewed using 2024 post-development volumes for the AM and PM peak hours. The analysis summary for signal, left- and right-turn lane warrants is presented below. The warrant analysis calculations are provided in Appendix K for reference.

Traffic Signal

The *Manual on Uniform Traffic Control Devices* (MUTCD), 2009 Edition, provides guidance and standards on the evaluation of traffic conditions to determine the need for traffic signalization at unsignalized intersections. A screening level comparison of peak traffic volumes with the lowest MUTCD volume threshold (100 vehicles per hour for the minor street approach) was performed to determine if a more detailed signal warrants analysis should be performed for the SW Leveton Drive/SW 108th Avenue intersection.

The MUTCD Warrant 3, Peak Hour volume thresholds are not met at the SW Leveton Drive/SW 108th Avenue intersection with the proposed office building. Therefore, no additional analysis was prepared.

We also reviewed hourly volumes for the SW Tualatin Road/SW Teton Avenue intersection to determine if a signal at this location is appropriate to mitigate the long delay for the northbound left-turn movement. The projected 2024 post-development that volumes at this location do not meet the thresholds for Warrant 1 (8-Hour Vehicular Volume), Warrant 2 (Four-Hour Vehicular Volume), and Warrant 3 (Peak Hour Vehicular Volume). Additionally, the crash analysis did not show excessive crashes at this intersection, nor any fatalities or pedestrian/bicyclist crashes within the last five (5) years of crash data. Because the SimTraffic analysis showed delays for the northbound left-turn movement are closer to the observed delays in the field, we don't recommend any improvements at this location.

Turn Lanes

Turn-lane criteria were reviewed for the proposed driveways on SW 108th Avenue using the left- and right-turn lane criteria established by the Texas Transportation Institute (TTI) for unsignalized intersections.

SW 108th Avenue is currently a two-lane roadway with no existing turn lanes into the site. While the estimated left-turn volumes at the proposed site accesses are high, the opposing traffic volumes are projected to be well below the threshold for either left- or right-turn lanes. Additionally, the delays for the turn movements at the site driveways are estimated to be relatively low. Therefore, no turn lanes are proposed on SW 108th Avenue or on SW Leveton Drive.

VIII. RECOMMENDATIONS AND MITIGATION

All study area intersections currently operate within City of Tualatin mobility standards except the SW Tualatin Road/SW Teton Avenue intersection. The northbound left-turn movement at this location currently has a delay greater than 90 seconds which exceeds the City's LOS E standard for an unsignalized intersection, as reported by Synchro software; however, video observations of existing conditions show delays for this movement are closer to 14 seconds. Similarly, the delay reported by SimTraffic for existing conditions is approximately 27 seconds. Therefore, we estimate the delay under 2024 post-development conditions will be approximately 40 seconds as reported by SimTraffic software, and corresponding with an LOS E.

All other study area intersections are projected to operate at acceptable levels, as reported by Synchro software. While queues during the peak 15-minute periods of the morning and afternoon show some queuing that exceeds available storage, queues for the remainder of the AM and PM peak hours are expected to be accommodated within existing queue storage areas. Therefore, no other improvements are recommended at this time.

IX. APPENDIX

Appendix A. Figures

Appendix B. Scoping Material

Appendix C. Transit Information

Appendix D. Traffic Count Summaries

Appendix E. Seasonal Adjustment Data

Appendix F. Crash Data

Appendix G. In-Process Data

Appendix H. Signal Information

Appendix I. Operations Calculations

Appendix J. Queuing Analysis

Appendix K. Warrants