REVISED TRAFFIC IMPACT ANALYSIS

INNOVATION STARBUCKS

INNOVATION PARK DRIVE/TANGERINE ROAD

REVISED 30 MAY 2024
7 MARCH 2024
5 OCTOBER 2023
19 DECEMBER 2022

REVIEWED - NO COMMENTS

Engineering: chuelle 07/01/2024

The issuance of a permit shall not be construed to be a permit or approval of any violation of the codes or ordinances of the Town of Oro Valley

PREPARED FOR
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INNOVATION STARBUCKS
INNOVATION PARK DRIVE/TANGERINE ROAD
REVISED TRAFFIC IMPACT ANALYSIS

Executive Summary

The purpose of this traffic study is to evaluate the current and future transportation system within the project study area surrounding the site without and with the proposed Innovation Starbucks project.

Existing Traffic Data

The study intersections of Innovation Park Drive/Tangerine Road, Vistoso Park Road South/Innovation Park Drive, and Orthopedic Driveway/Vistoso Park Road South currently operate at an adequate Level of Service (LOS).

Future Traffic Data Without Project

The study intersections are expected to continue to operate at an adequate LOS without the project in 2024.

Future Traffic Data With Project

All of the study intersections are expected to operate at an adequate LOS without and with the project in 2024.

While the intersection of West Access/Innovation Park Drive is approximately 45 feet short of typical Oro Valley driveway spacing (330 feet), there is only about 600 feet between Tangerine Road and Vistoso Park Road. Its location in the middle between these two roadways is not expected to impact driver expectations in the area. Furthermore, as a right in/right out only driveway, with a northbound left turn lane, the intersection is expected to operate at an adequate level of service.

Turn Lane Analysis

An eastbound right turn lane is not warranted at North Access.

The northbound right turning movement at West Access/Innovation Park Drive and the westbound right turning movements at South Access/Tangerine Road and Innovation Park Drive/Tangerine Road are expected to generate queues of 100 feet or less without considerations for braking distance, gap or taper. However, being in an urban environment, the braking maneuver is expected to occur prior to the turn lane taper rather than within the turn lane.

The northbound right turn lane at West Access/Innovation Park Drive is expected to provide adequate storage for vehicle queues.

Drive-Through Queue Analysis

The proposed vehicle storage space for the drive-through window lane at the coffee shop is expected to meet the needs of this establishment. However, Town of Oro Valley observations at a similar site show a maximum queue can peak at seventeen (17) vehicles.

In the event this occurs, an additional 75 feet of queueing space is available within the internal parking lot where it is anticipated to not block traffic entering at West Access or traffic operations at the driveways to the site located along Ina Road and Innovation Park Drive.

Internal Circulation Analysis

A series of east/west and north/south aligned crosswalks and sidewalks are proposed within the Innovation Starbucks development enabling pedestrians within the site to walk between the establishments. Additionally, a multi-use path will be provided on the north side of Tangerine Road between the intersections of Innovation Park Drive and South Access. This new multi-use path will allow pedestrians to walk between the proposed project and the existing sidewalk facilities on Innovation Park Drive and the pedestrian/bike path on the south side of Tangerine Road.

Driveway throat lengths allow entering/exiting vehicles to smoothly transition between the adjacent roads and the site without unexpected vehicles turning from internal drive aisles, or parking maneuvers, being located immediately adjacent to the actual driveway transitions.

The main drive aisles are intuitive and offer clear paths of travel.

Recommendations

The existing westbound right turn lane at the intersection of Innovation Park Drive/Tangerine Road will be extended east to act as a continuous right turn lane serving both intersections of Innovation Park Drive and South Access along Tangerine Road per Town of Oro Valley direction. While the storage requirements for the westbound right turn lane at South Access/Tangerine Road are expected to be less than 100 feet, in order to meet the Town of Oro Valley guidelines, the existing westbound right turn lane at the intersection of Innovation Park Drive/Tangerine Road should be extended for an additional 150 feet east of South Access/Tangerine Road.

Due to the location of West Access/Innovation Park Drive the proposed northbound right turn lane on Innovation Park Drive should be maximized to fit in the available geometry.

With the construction of West Access/Innovation Park Drive, the taper for the existing northbound right turn lane at the intersection of Vistoso Park Road South/Innovation Park Drive should be reconstructed to start after the curb return for the proposed northbound right turn lane at the intersection of West Access/Innovation Park Drive.

The eastbound right turn lane at the intersection Vistoso Park Road South/Innovation Park Drive should be restriped as a shared through/right turn lane.

INNOVATION STARBUCKS
INNOVATION PARK DRIVE/TANGERINE ROAD
REVISED TRAFFIC IMPACT ANALYSIS

Project Description

VWI/Vistoso Development Inc is proposing a mixed use site with a 2,400 square foot coffee shop with drive through window lane, 4,000 square foot high-turnover sit-down restaurant with drive through window lane, and 27,000 square feet of general office buildings on the Northeast corner of Innovation Park Drive/Tangerine Road in Oro Valley, Arizona. The vicinity of the project is shown in **Figure 1**. The site will be located as shown in **Figure 2**. The expected opening year of the project is 2024 and three new access points are proposed to serve the site, one of which aligns with an existing intersection. The proposed project will be built in two phases, the first phase will consist of the coffee shop with drive through window in addition to all three access points. The second phase will consist of the high-turnover sit-down restaurant and the general office buildings. To provide a conservative analysis, this report assumes all buildings will be constructed in the first phase. The purpose of this traffic impact analysis is to:

- Evaluate the current and future operational characteristics of the adjacent roadway network surrounding the project site.
- Estimate the traffic generation associated with the project and assign that traffic to the existing roadway system.
- Analyze future traffic operations at three existing intersections and three proposed access points, one of which aligns with an existing intersection.
- Determine the need for auxiliary (left and right turn) lanes at the access points that will serve the project site.
- Conduct an internal circulation focusing on internal vehicular movements within the project site.
- Analyze the queue in the drive-through window lane for the coffee shop from the peak hour traffic volume.

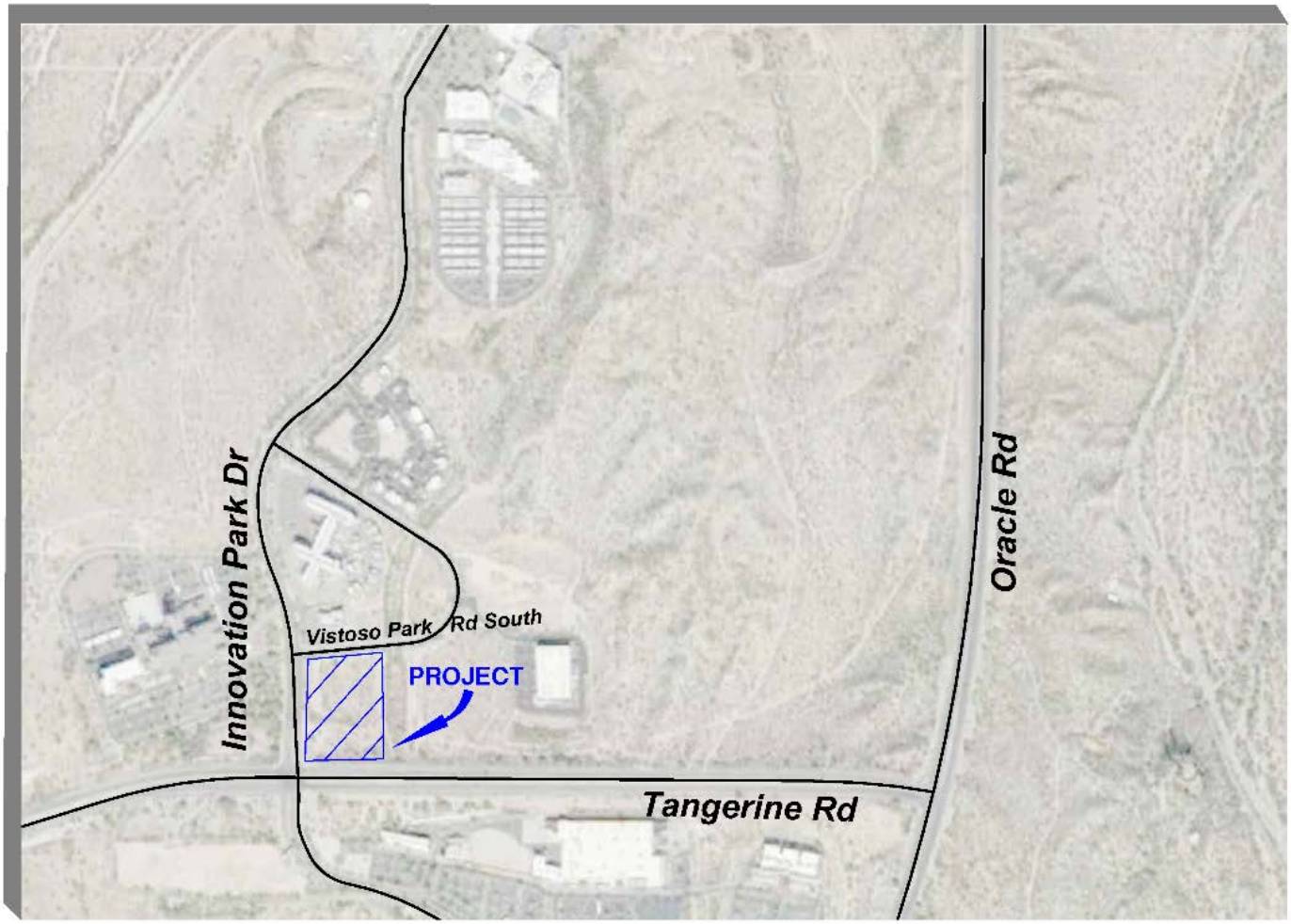
The author of this report is a registered Professional Engineer (Civil) in the State of Arizona having specific expertise and experience in the preparation of traffic impact analyses.

Study Methodology

In order to analyze and evaluate the potential traffic impacts of the proposed development, the following tasks were undertaken:

- Field observation of the proposed site and surrounding area was conducted to evaluate the existing physical and operational characteristics of the adjacent roadway network.
- Site traffic volumes generated by the proposed site were calculated using the *Institute of Transportation Engineers (ITE) Trip Generation Manual, 11th Edition,* 2021.
- Calculated site traffic was distributed based on existing traffic patterns and assigned to the primary roadways within the project study limits.

Figure 1 – Vicinity Map

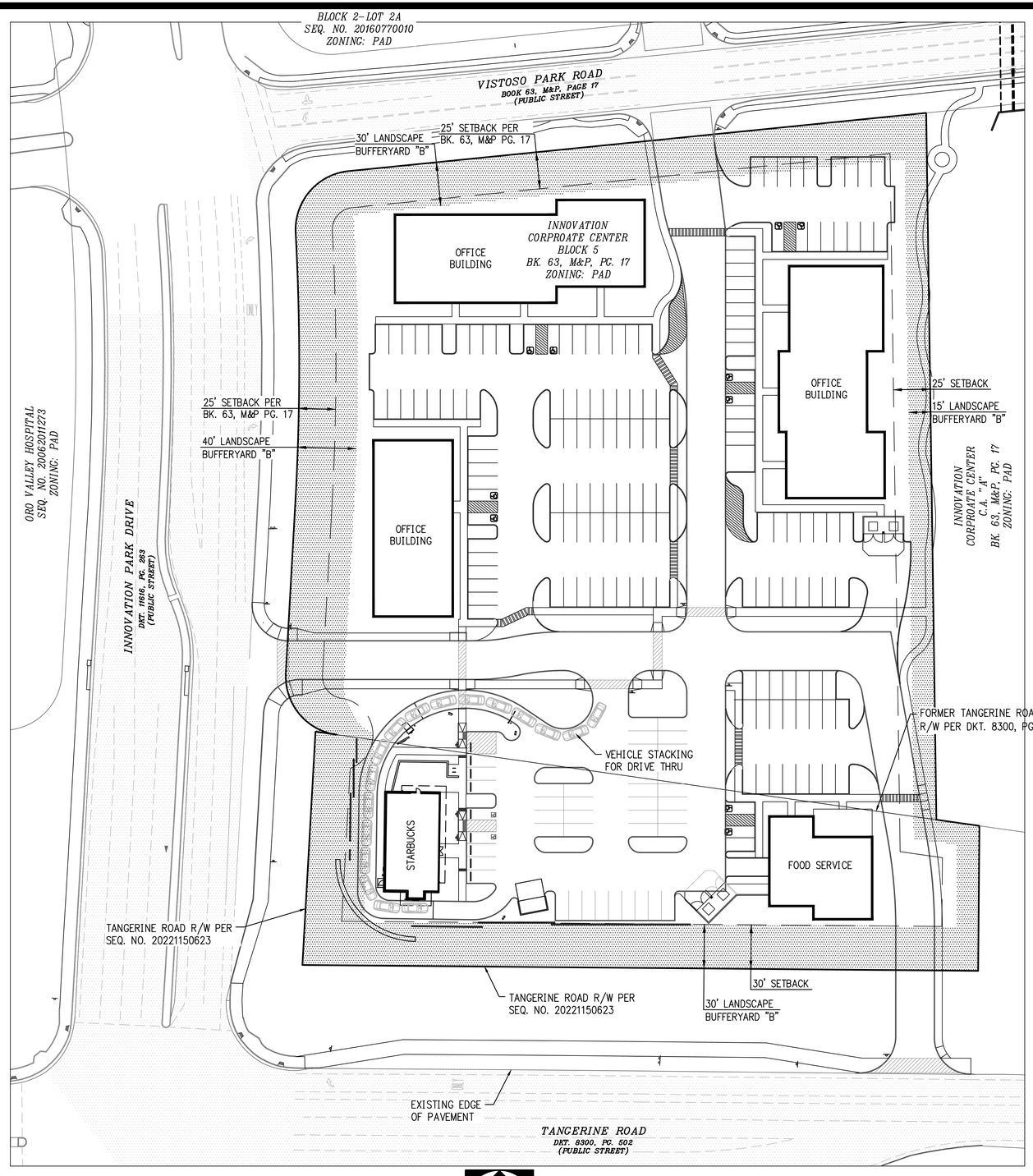


LEGEND:

= *New Access*

= *Existing Road*

= *Project Site*



0' 40' 80' 120'

PROJECT OVERVIEW

2300167
REF: 2201099

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811
Call 811 or click Arizona811.com

The WLB Group Inc. **WLB**

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Landscape Architecture Urban Design
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(520) 881-7480

Project: **STARBUCKS COFFEE**
A PORTION OF BLOCK 5 OF THE INNOVATION CORPORATE CENTER
FINAL PLAT, BOOK 63, M&P PAGE 17, ORO VALLEY, ARIZONA

Sheet Title: **MASTER DEVELOPMENT PLAN SHEET**
DEVELOPMENT PLAN

No.	Date	Item

Revisions

Scale	AS SHOWN
Job No.	185050-VW-30/0105
Date	JANUARY 2024
Designed By	DWL/JAW
Checked By	DWL

Registered Professional Engineer (Civil) CERTIFICATE NO. 36234 DAVID W. LITTLE ARIZONA U.S.A.

Sheet 3 of 11

- Capacity analyses were performed for the existing conditions and future (2024) conditions without and with the project using the methodology presented in the *2016 Highway Capacity Manual, 6th Edition (HCM 6th)*.
- The need for auxiliary lanes at the study access points based on Oro Valley guidelines.
- An internal circulation analysis was performed using the project site plan focusing on internal vehicular movements within the project site.
- Queue analysis was calculated using the peak hour traffic volumes and drive-through window service rates associated with the project to determine the queues at the two new drive-through window lanes and their impact on the internal circulation of the project site.

Existing Conditions

The project site is located on the northeast corner of Innovation Park Drive/Tangerine Road in Oro Valley, Arizona.

Tangerine Road is an east/west aligned roadway that provides access between Interstate 10 (I-10) to the west and State Route 77 (SR 77) to the east. Adjacent to the project site, Tangerine Road is a median divided roadway with two lanes in each direction of travel. Curb and gutter are not provided, yet an offset pedestrian/bike path is on the south side of Tangerine Road. The posted speed limit is 45 miles per hour (mph).

Vistoso Park Road is an east/west aligned roadway near the project site but winds to reconnect with Innovation Park Drive approximately 0.25 miles north of the project site. One through lane is provided in each direction of travel separated by a two way center left turn lane. Curb, gutter, and sidewalk facilities are provided on both sides of the roadway. The posted speed limit is 25 mph. For this report, the south portion of this road is named Vistoso Park Road South.

Innovation Park Drive is a north/south aligned roadway that reconnects to SR 77 roughly 1.75 miles north of the project site and approximately 1 mile south of the project site. Two through lanes are provided in each direction of travel separated by a raised median. Curb, gutter, and sidewalk facilities are provided on both sides of the roadway north of Tangerine Road. The posted speed limit is 35 mph.

The intersection of Innovation Park Drive/Tangerine Road forms a signalized four-leg intersection. Eastbound traffic approaching the intersection is provided two exclusive left turn lanes, two through lanes, and two dedicated right turn lanes. Westbound vehicles approaching the intersection are offered two left turn lanes, two through lanes, and a right turn lane. The northbound approach is offered two exclusive left turn lanes, a through lane, a shared through/right turn lane, and exclusive right turn lane. Southbound traffic approaching the intersection is provided an exclusive left turn lane, two through lanes, and a dedicated right turn lane. All approaches at the intersection operate under protected left turn phasing. A NO U-TURN (R3-4) sign is provided for the northbound approach to the intersection.

The intersection of Vistoso Park Road South/Innovation Park Drive is a four-leg unsignalized intersection. Eastbound and westbound vehicles approaching the intersection are STOP controlled while traffic approaching the intersection from the northbound and southbound operate under free flow conditions. Eastbound vehicles approaching the intersection are provided with an exclusive left turn lane and dedicated right turn lane. The westbound approach is offered an exclusive left turn lane and a shared through/right turn lane. Northbound traffic approaching the intersection makes use of an exclusive left turn lane, two through lanes, and a dedicated right turn lane. Southbound vehicles approaching the intersection are provided with a left turn lane, through lane, and shared through/right turn lane.

The intersection of Orthopedic Driveway/Vistoso Park Road South is a four-leg unsignalized intersection. Eastbound and westbound vehicles operate under free flow conditions and southbound vehicles are STOP controlled. The south leg of the intersection currently exists as a driveway 'stub-out' and will serve the proposed project. Eastbound vehicles approaching the intersection are provided a two way center left turn lane and one through lane while westbound vehicles are offered a shared through/right turn lane. Southbound vehicles are offered a shared left/right turn lane.

The study intersection locations, lane configurations, and intersection control are shown in **Figure 3**.

Existing Traffic Data

In order to form a basis for analysis of the project impacts, weekday AM and PM peak hour turning movement counts were conducted at the intersections of Tangerine Road/Innovation Park Drive, Vistoso Park Road South/Innovation Park Drive, and Orthopedic Driveway/Vistoso Park Road South.

The weekday turning movement counts were conducted from 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM. All traffic data was collected in August 2022 while school was in session. The existing traffic volumes are shown in **Figure 4**. Complete traffic count data can be found in the Appendix.

Access

Three access points will be constructed to serve the project, one on Tangerine Road (South Access), one on Innovation Park Drive (West Access), and one on Vistoso Park Road South (North Access).

Figure 3 – Existing Lane Configurations and Traffic Control

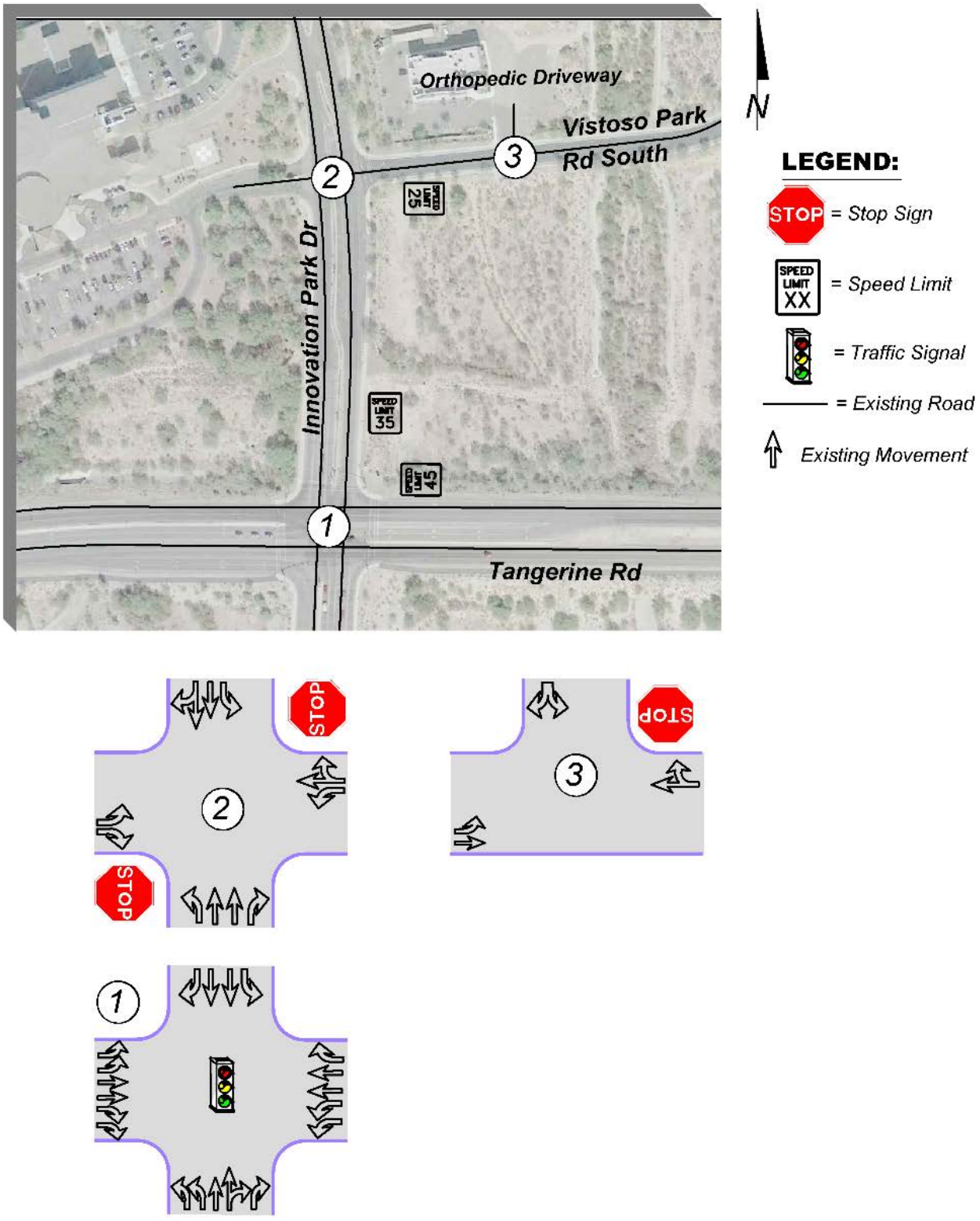
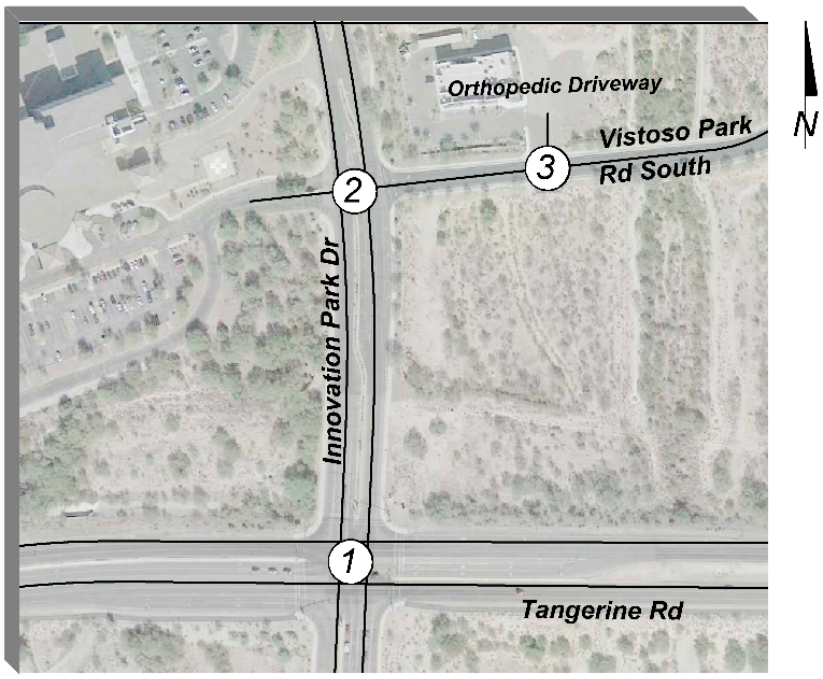
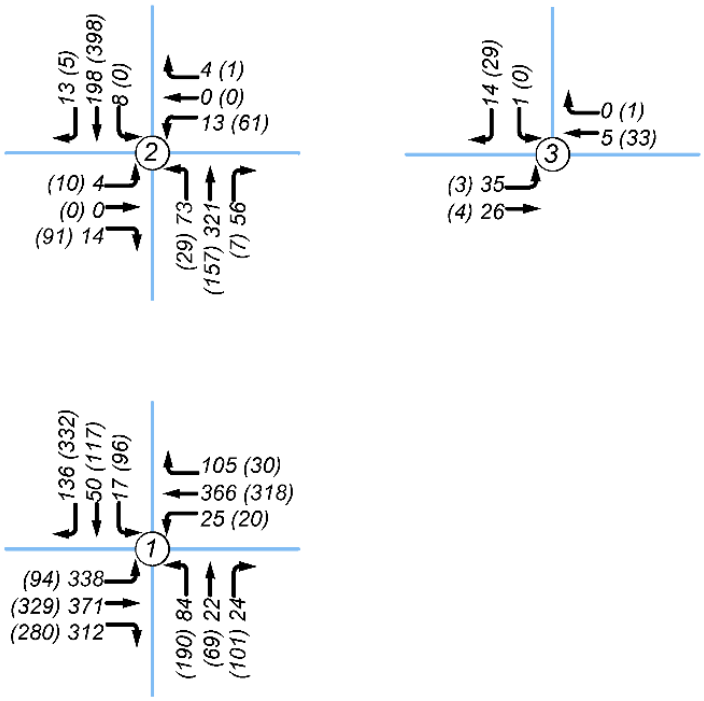


Figure 4 – Existing Weekday Peak Hour Traffic Volumes



LEGEND:

XX = Weekday AM Peak Hour
(XX) = Weekday PM Peak Hour
——— = Existing Road



South Access will be located on Tangerine Road approximately 450 feet east of Innovation Park Drive and will be limited to right in/right out only access. The existing westbound right turn lane at Innovation Park Drive/Tangerine Road will be reconstructed to provide a continuous right turn lane that serves both Innovation Park Drive/Tangerine Road and South Access/Tangerine Road. Westbound traffic approaching the site will make use of two through lanes and exclusive right turn lane. Southbound vehicles exiting the site will be offered a right turn lane. Traffic on Tangerine Road will remain free flow while southbound traffic exiting the site will be STOP controlled.

West Access is 285 feet (center line to center line) north of Tangerine Road and will offer right in/right out only access. West Access will serve as the primary access for vehicles entering the site from the eastbound direction on Tangerine Road and the primary exit for vehicles traveling northbound on Innovation Park Drive. Northbound vehicles on Innovation Park Drive approaching the site will remain free flow and will make use of two through lanes and dedicated right turn lane. Westbound vehicles exiting the site will be STOP controlled and offered a right turn lane. As part of the proposed project, the curb return on the north side of West Access will 'bulb-out' to provide a clear delineation between the northbound right turn lanes at West Access and Vistoso Park Road South along Innovation Park Drive.

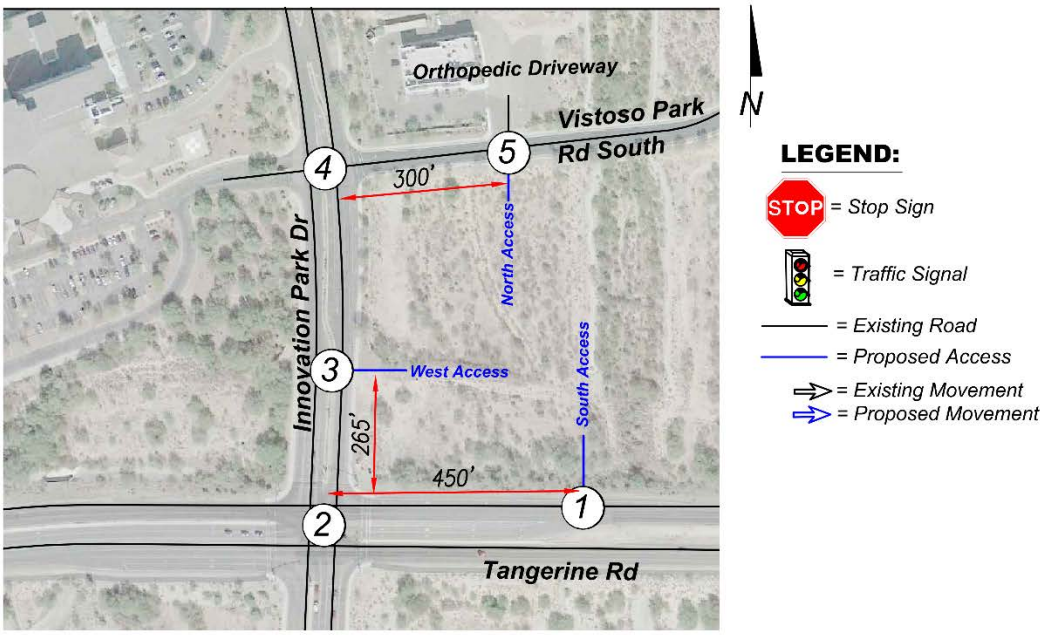
North Access is a new southern leg at the existing intersection of Orthopedic Driveway/Vistoso Park Road South. The new leg is approximately 300 feet east of Innovation Park Drive and will offer full access to the site. Traffic on Vistoso Park Road South will remain free flow while northbound vehicles exiting the site will be STOP controlled. Eastbound and westbound vehicles will make use of an exclusive left turn lane and a shared through/right turn lane, northbound vehicles exiting the site will be provided a shared left/through/right turn lane.

Figure 5 shows the locations, geometry, and spacing for the proposed access points serving the project site that will serve as a baseline of analysis in the report.

Trip Generation

Trip generation was developed utilizing nationally agreed upon data contained in the Institute of Transportation Engineers (ITE) publication *Trip Generation, 11th Edition,* 2021. The project trip generation was estimated for the construction of a 2,400 square foot coffee shop with drive through window based on ITE Land Use Code 937 (LUC 937) Coffee Shop with Drive-Through Window, a 4,000 square foot high-turnover sit-down restaurant based on ITE Land Use Code 932 (LUC 932) High-Turnover Sit-Down Restaurant, and 27,000 square feet of general office buildings based on ITE Land Use Code 710 (LUC 710) General Office Building. The result is the expected weekday trip generation for the project as shown in **Table 1**. The complete trip generation calculations can be found in the Appendix.

Figure 5 – Baseline Access Point and Intersection Configuration Assumptions



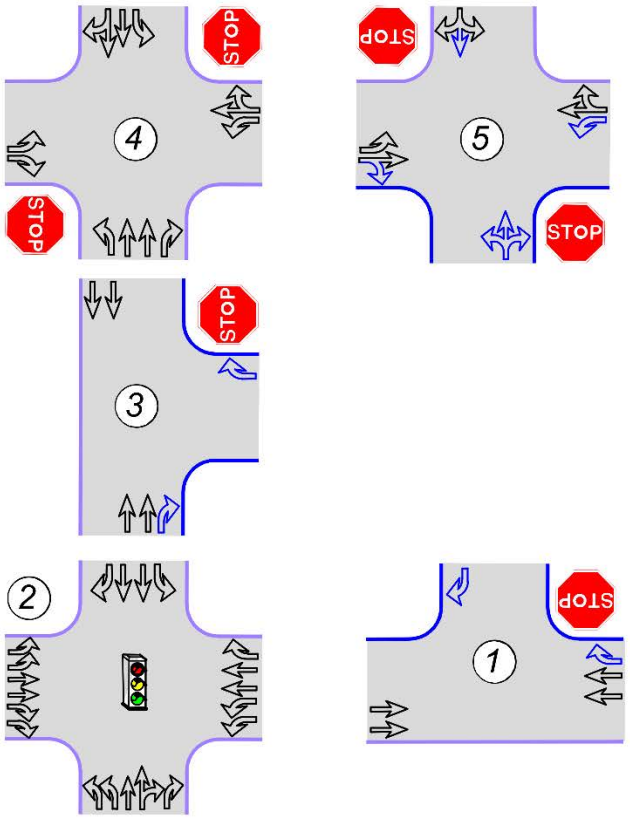


Table 1 – Project Site Generated Trips

Time Period	Coffee Shop with Drive-Through Window (937)	High-Turnover Sit-Down Restaurant (932)	General Office Building (710)	Total
Average Daily, Inbound (vtpd)	641	215	147	1,003
Average Daily, Outbound (vtpd)	641	215	147	1,003
Total Daily	**1,282**	**430**	**294**	**2,006**
AM Peak Hour, Inbound (vtph)	106	21	37	164
AM Peak Hour, Outbound (vtph)	101	18	5	124
Total AM Peak	**207**	**39**	**42**	**288**
PM Peak Hour, Inbound (vtph)	47	23	7	76
PM Peak Hour, Outbound (vtph)	47	14	32	94
Total PM Peak	**94**	**37**	**39**	**170**

vtpd - vehicle trips per day, vtph - vehicle trips per hour

Trip Distribution & Assignment

Trip distribution for the project was based on existing traffic volume patterns and the surrounding roadway network. **Figure 6** shows the weekday trip distribution for the project as a percentage of net new primary trips.

Figure 7 shows the assignment of the new site generated trips to the project intersections within the study area.

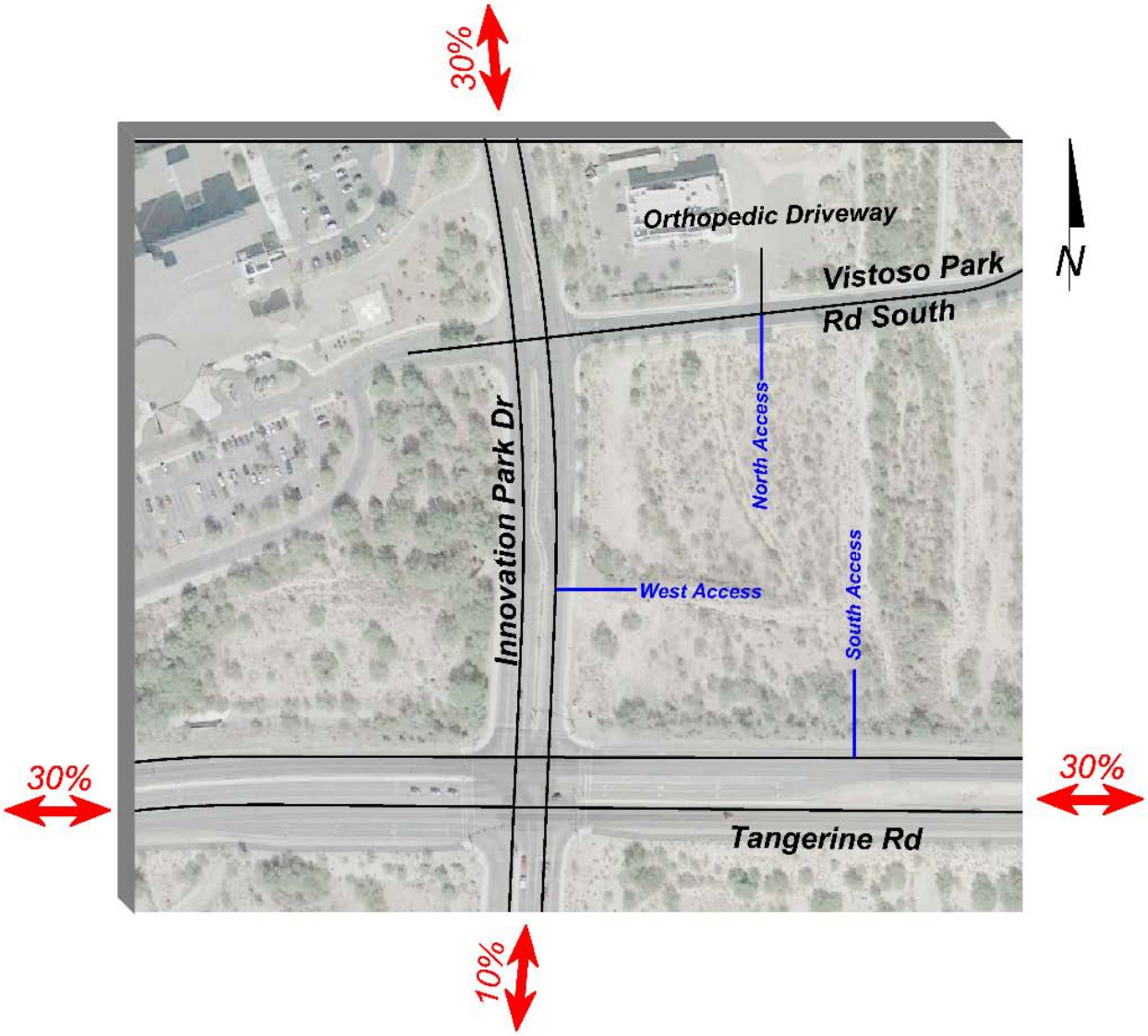
Existing Traffic Operations

Analysis of current intersection operations was conducted for the weekday AM and PM peak hours using the nationally accepted methodology set forth in the *Highway Capacity Manual*, Transportation Research Board, 2016 (HCM 6th). The computer software Synchro 11 was utilized to calculate the levels of service for individual movements and approaches.

LOS is a qualitative measure of the traffic operations at an intersection or on a roadway segment. Level of service is ranked from LOS A, which signifies little or no congestion and is the highest rank, to LOS F, which signifies congestion and jam conditions. LOS D is typically considered adequate operation at signalized and un-signalized intersections in developed areas.

At signalized intersections, level of service is calculated for each movement and then summed in a weighted fashion to yield the LOS for the approach and for the intersections as a whole. Criteria for level of service at signalized intersections are shown in **Table 2.**

Figure 6 – Weekday Peak Hour Trip Distribution



LEGEND:

= Existing Road

= New Access

XX% Distribution of Vehicle Trips

Figure 7 –Weekday Peak Hour Trip Assignment

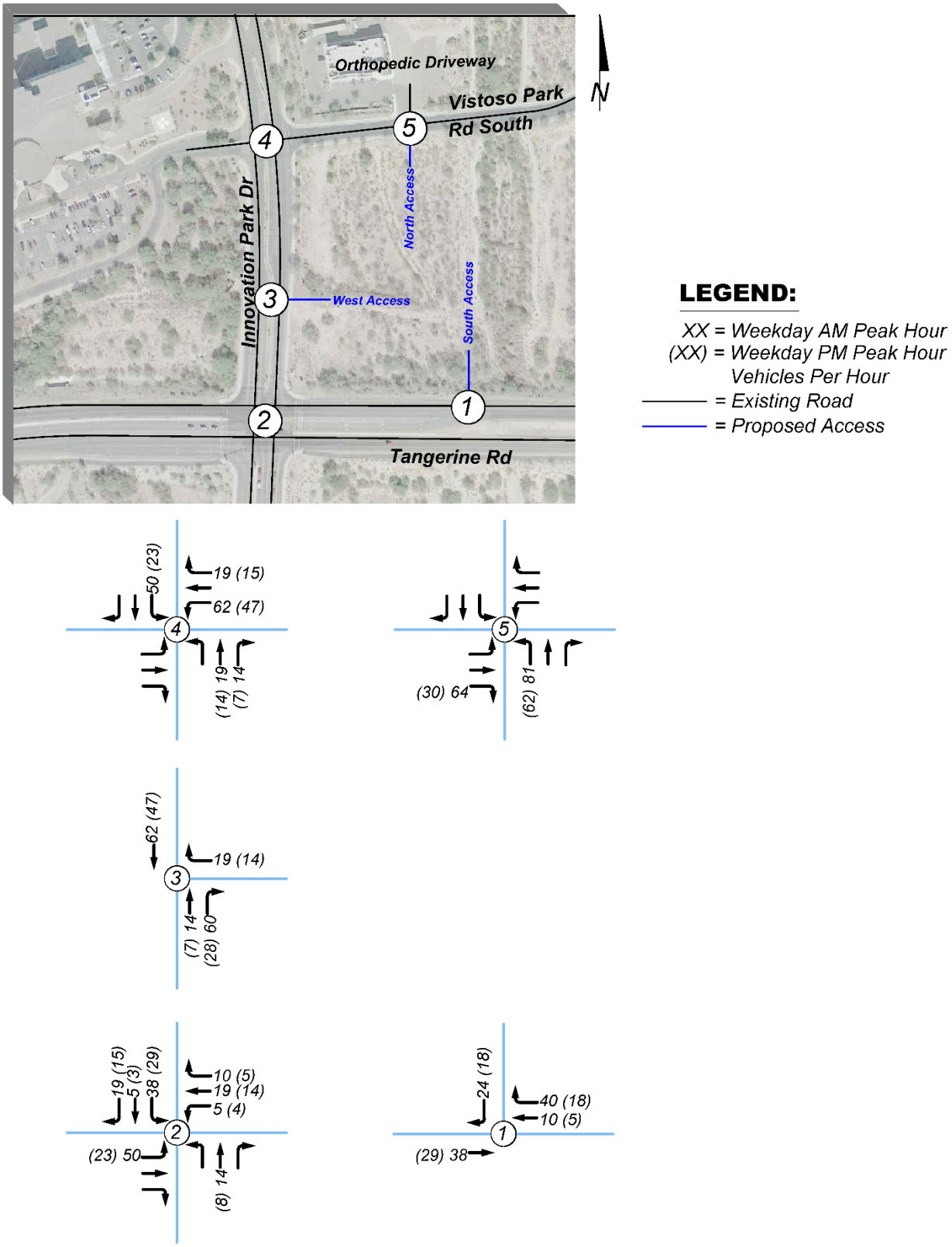


Table 2 - Level of Service Criteria – Signalized Intersections

Level-of-Service	Average Total Delay
A	≤ 10.0 seconds/vehicle
B	> 10.0 and ≤ 20.0 seconds/vehicle
C	> 20.0 and ≤ 35.0 seconds/vehicle
D	> 35.0 and ≤ 55.0 seconds/vehicle
E	> 55.0 and ≤ 80.0 seconds/vehicle
F	> 80.0 seconds/vehicle

In calculating the levels of service, assumed signal phasing and timing data was used. Other assumptions included:

- Cycle length – 90 seconds
- Lane widths – 12 feet
- Approach grade – 0%
- Right turn on red allowed

At un-signalized intersections, level of service is predicted/calculated for those movements which must either stop for or yield to oncoming traffic and is based on average control delay for the particular movement. Control delay is the portion of total delay attributed to traffic control measures such as stop signs and traffic signals. The criteria for level of service at un-signalized intersections are shown below in **Table 3**.

Table 3 – Level of Service Criteria – Un-signalized Intersections

Level-of-Service	Delay
A	≤ 10 seconds per vehicle
B	> 10 and ≤ 15 seconds/vehicle
C	> 15 and ≤ 25 seconds/vehicle
D	> 25 and ≤ 35 seconds/vehicle
E	> 35 and ≤ 50 seconds/vehicle
F	> 50 seconds per vehicle

Table 4 shows the existing levels of service that were calculated for the study intersections. Complete capacity calculations are included in the Appendix.

Table 4 – Existing Weekday Peak Hour Levels of Service

Intersection	AM Peak		PM Peak	
	LOS	Delay	LOS	Delay
Signalized Intersections				
Innovation Park Drive/Tangerine Road				
Overall Intersection	C	25.1	C	26.5
Eastbound Left	C	34.3	D	38.6
Eastbound Through	B	18.7	C	27.6
Eastbound Right	B	17.2	C	25.2
Westbound Left	D	42.2	D	41.7
Westbound Through	C	28.5	C	31.1
Westbound Right	C	25.2	C	27.4
Northbound Left	D	37.6	D	35.2
Northbound Through	B	16.7	B	14.4
Northbound Through/Right	B	16.6	B	14.2
Southbound Left	D	44.4	D	40.8
Southbound Through	B	19.1	B	15.4
Southbound Right	B	19.7	B	18.3
Un-Signalized Intersections				
Vistoso Park Road/Innovation Drive				
Eastbound Left	C	15.3	C	15.4
Eastbound Through/Right	A	9.1	B	10.4
Westbound Left	C	16.9	C	16.7
Westbound Through/Right	A	9.3	A	8.8
Northbound Left	A	7.9	A	8.3
Soutthbound Left	A	8.2	A	7.6
Vistoso Park Road/Orthopedic Driveway				
Eastbound Left	A	7.3	A	7.3
Southbound Left/Right	A	8.5	A	8.6

Delay - seconds per vehicle

As shown in **Table 4**, all of the study intersections currently operate at an adequate LOS.

Future Traffic Operations Without Project

In order to assess the impacts of the project on future traffic operations, traffic projections were made for the opening year of 2024. Pima Association of Governments historical traffic counts within the study area show an average 2% annual traffic growth rate in the area over the last several years. Using a 2% annual compounded growth rate, 2024 weekday peak hour traffic volumes without the project were estimated as shown in **Figure 8**.

As with the current volumes, levels of service were calculated for each of the intersections in the study area for 2024 without the project. These calculations are shown in **Table 5**. Complete capacity calculations are included in the Appendix.

Figure 8 – 2024 Weekday Peak Hour Traffic Volumes Without Project

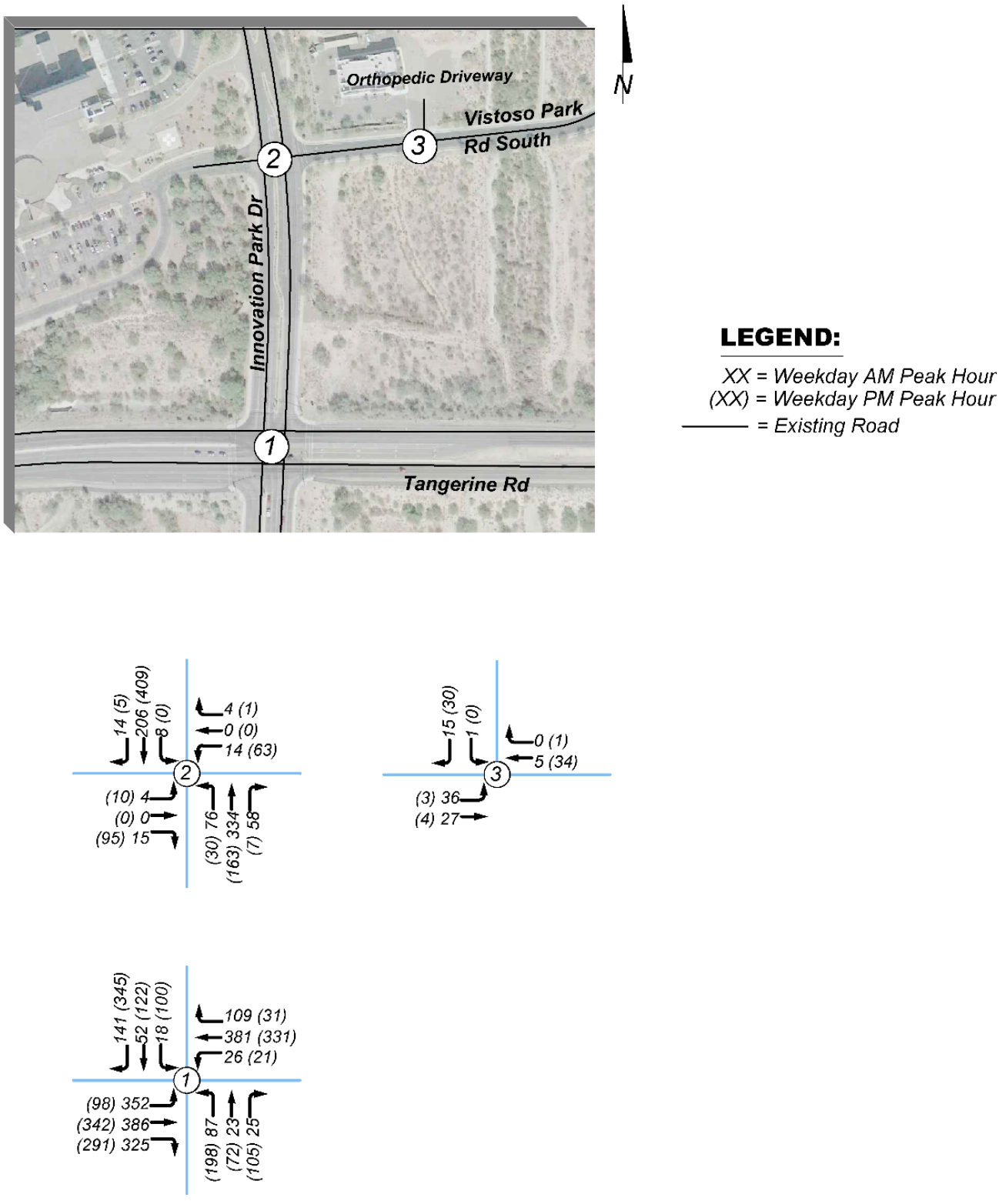


Table 5 – 2024 Weekday Peak Hour Levels of Service Without Project

Intersection	AM Peak		PM Peak	
	LOS	Delay	LOS	Delay
Signalized Intersections				
Innovation Park Drive/Tangerine Road				
Overall Intersection	C	25.3	C	27.2
Eastbound Left	C	34.6	D	39.7
Eastbound Through	B	18.6	C	28.3
Eastbound Right	B	17.1	C	25.7
Westbound Left	D	43.0	D	42.7
Westbound Through	C	28.8	C	31.9
Westbound Right	C	25.3	C	27.9
Northbound Left	D	38.1	D	36.0
Northbound Through	B	17.0	B	14.4
Northbound Through/Right	B	17.0	B	14.2
Southbound Left	D	46.1	D	44.0
Southbound Through	B	19.4	B	15.6
Southbound Right	C	20.0	B	18.9
Un-Signalized Intersections				
Vistoso Park Road/Innovation Drive				
Eastbound Left	C	15.7	C	15.9
Eastbound Through/Right	A	9.1	B	10.5
Westbound Left	C	17.5	C	17.4
Westbound Through/Right	A	9.4	A	8.8
Northbound Left	A	8.0	A	8.4
Soutthbound Left	A	8.3	A	7.7
Orthopedic Driveway/Vistoso Park Road				
Eastbound Left	A	7.3	A	7.3
Southbound Left/Right	A	8.5	A	8.6

Delay - seconds per vehicle

As shown in **Table 5**, all of the study intersections are expected to continue to operate with an adequate LOS in 2024 without the project.

Future Traffic Operations With Project

In order to assess the impacts of the project on future traffic operations, levels of service were calculated for each project intersection in 2024 with traffic from the project. Weekday peak hour traffic volumes for 2024 without the project (**Figure 8**) were combined with the estimated trips generated by the project (**Figure 7**) to yield weekday peak hour traffic volumes with the project as shown in **Figure 9**.

Weekday intersection levels of service for 2024 with the project were then calculated as shown in **Table 6**. Complete capacity calculations are included in the Appendix.

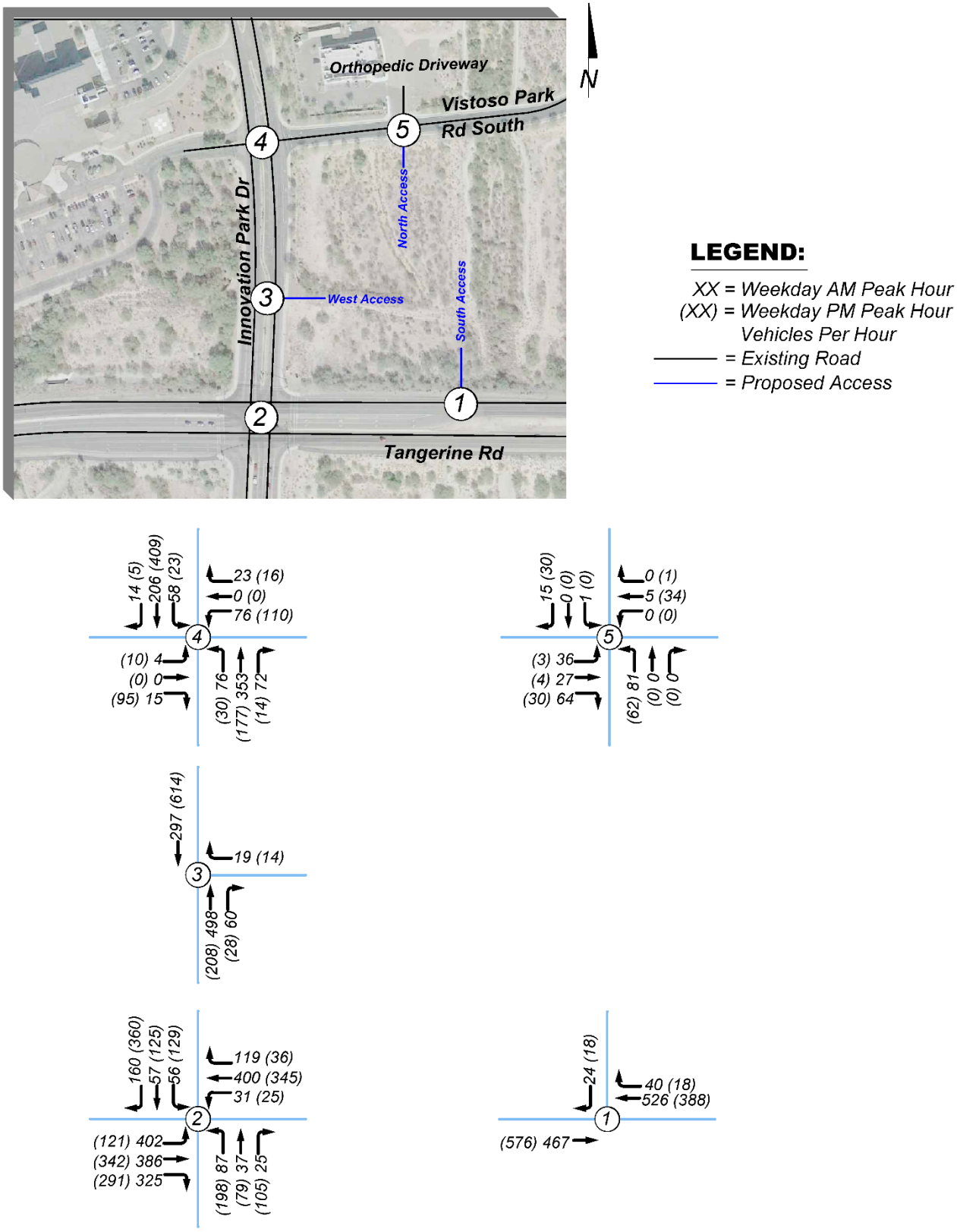
Table 6– 2024 Weekday Peak Hour Levels of Service With Project

Intersection	2024 Without Project				2024 With Project			
	AM Peak		PM Peak		AM Peak		PM Peak	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Signalized Intersections								
Innovation Park Drive/Tangerine Road								
Overall Intersection	C	25.3	C	27.2	C	25.5	C	28.0
Eastbound Left	C	34.6	D	39.7	C	33.5	D	38.1
Eastbound Through	B	18.6	C	28.3	B	18.2	C	27.8
Eastbound Right	B	17.1	C	25.7	B	16.7	C	25.4
Westbound Left	D	43.0	D	42.7	D	39.4	D	41.3
Westbound Through	C	28.8	C	31.9	C	29.1	C	32.7
Westbound Right	C	25.3	C	27.9	C	25.2	C	28.4
Northbound Left	D	38.1	D	36.0	D	37.6	D	37.9
Northbound Through	B	17.0	B	14.4	C	21.2	B	18.0
Northbound Through/Right	B	17.0	B	14.2	C	21.0	B	17.7
Southbound Left	D	46.1	D	44.0	D	37.8	D	38.9
Southbound Through	B	19.4	B	15.6	C	20.4	B	16.9
Southbound Right	C	20.0	B	18.9	C	21.2	C	21.0
Un-Signalized Intersections								
Vistoso Park Road/Innovation Drive								
Eastbound Left	C	15.7	C	15.9	C	19.6	C	17.2
Eastbound Through/Right	A	9.1	B	10.5	A	9.1	B	10.5
Westbound Left	C	17.5	C	17.4	D	31.6	C	22.9
Westbound Through/Right	A	9.4	A	8.8	A	9.6	A	9.0
Northbound Left	A	8.0	A	8.4	A	8.0	A	8.4
Southbound Left	A	8.3	A	7.7	A	8.6	A	7.7
Orthopedic Driveway/North Access/Vistoso Park Road								
Eastbound Left	A	7.3	A	7.3	A	7.3	A	7.3
Westbound Left	N/A		N/A		A	0.0	A	0.0
Northbound Left/Through/Right					B	10.5	A	9.6
Southbound Left/Right	A	8.5	A	8.6	A	8.5	A	8.6
South Access/Tangerine Road								
Southbound Right	N/A		N/A		B	10.3	A	9.7
West Access/Innovation Park Drive								
Westbound Right	N/A		N/A		B	10.2	A	9.1

Delay - seconds per vehicle

As shown in **Table 6**, all the study intersections are expected to operate at an adequate LOS without and with the project in 2024.

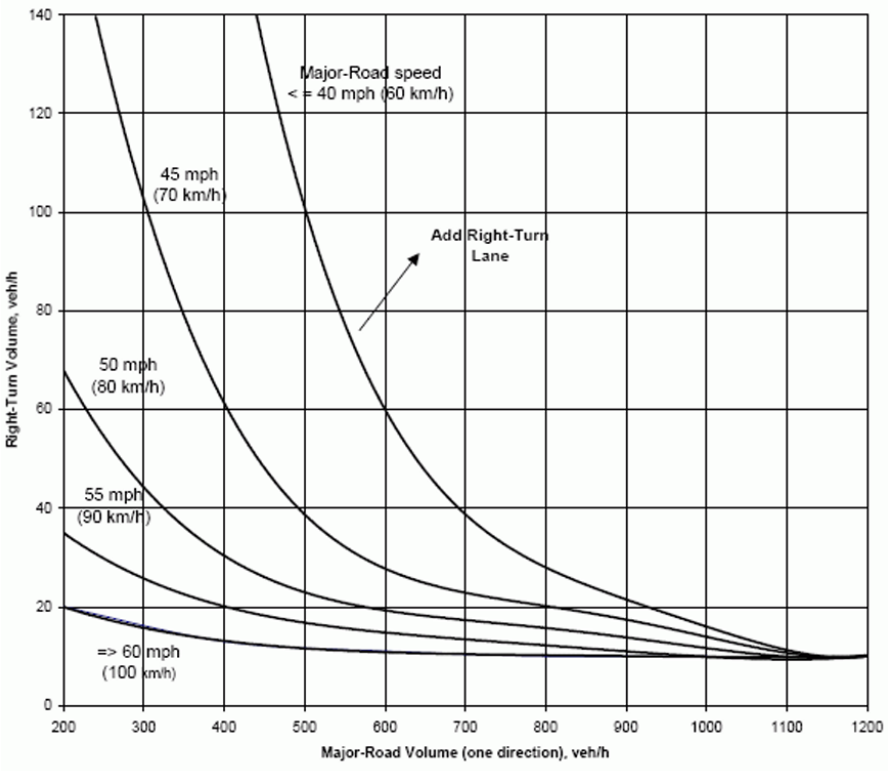
Figure 9 – 2024 Weekday Peak Hour Traffic Volumes With Project



Turn Lane Analysis

Right turn lanes are proposed at the intersections of West Access/Innovation Park Drive and South Access/Tangerine Road. A key element of this traffic analysis is to determine if a right turn lane is required at North Access. Turn lane needs were determined based on Town of Oro Valley policies which defer to the City of Tucson's *Access Management Guidelines*, dated December 2011. **Figure 10** shows the right turn lane warrant guidelines for a two lane roadway.

Figure 10 – City of Tuson Right Turn Lane Warrant- Two Lane Roadway



When needed, turn lanes remove the slowing turning traffic from the through traffic stream, improving capacity and reducing rear-end accidents. **Table 7** shows the location that was evaluated for a right turn lane with the project in 2024.

Table 7 – Turn Lane Warrants

Intersection	Direction	Turn Treatment Analyzed	Major Road Volume (veh/h)	Right Turn Volume (veh/h)	Turn Treatments Warranted?
North Access/Vistoso Park Rd South	Eastbound	Right Turn Lane	127	64	No

Table 7 shows that an eastbound right turn lane is not warranted at North Access.

Queue lengths for the proposed northbound right turning movement at West Access/Innovation Park Drive and the westbound right turning movements at South Access/Tangerine Road and Innovation Park Drive/Tangerine Road were calculated based on the following methods as recommended in *A Policy of Geometric Design of Highways and Streets* (AASHTO, 2011). Typically, an average vehicle length of 25 feet is assumed. For un-signalized intersections, storage for vehicles likely to arrive in an average two-minute period within the peak hour.

Vehicles per 2 min. period = (vehicles/hour) ÷ (30 periods/hour)
Storage length = vehicles per 2 min. period x 25 feet

Table 8 shows the calculated queue lengths based on 2024 weekday peak hour traffic volumes with traffic from the project. The computed values are typically rounded to the nearest 25 feet. Complete queue length calculations are available in the Appendix.

Table 8 – Calculated Queue Lengths

Intersection	Right Turn Storage			
	NB	SB	EB	WB
West Access/Innovation Park Road				
Turning Volume (vph)	60			
$S_{calculated}$ =	50			
$S_{rounded}$ =	50			
South Access/Tangerine Road				
Turning Volume (vph)				40
$S_{calculated}$ =				33
$S_{rounded}$ =				50
Innovation Park Road/Tangerine Road				
Turning Volume (vph)				119
$S_{calculated}$ =				99
$S_{rounded}$ =				100

S - storage in feet, vph - vehicles per hour

As shown in **Table 8**, the proposed northbound right turning movement at West Access/Innovation Park Drive and the proposed westbound right turning movements at South Access/Tangerine Road and Innovation Park Drive/Tangerine Road are expected to generate queues of 100 feet or less without considerations for turn lane braking distance, gap or taper. However, being in an urban environment, the braking maneuver is expected to occur prior to the turn lane taper rather than within the turn lane.

Per Town of Oro Valley direction, where possible, all turn lanes should be constructed to provide 150 feet of storage per the minimum requirements in the Pima County Department of Transportation and Tucson Department of Transportation Traffic Engineering Division Pavement Marking Appendix A.

The northbound right turn lane at West Access/Innovation Park Drive is expected to provide adequate storage for vehicle queues.

The existing westbound right turn lane at the intersection of Innovation Park Drive/Tangerine Road will be extended east to act as a continuous right turn lane serving both intersections of Innovation Park Drive and South Access along Tangerine Road per Town of Oro Valley direction. While the storage requirements for the westbound right turn lane at South Access/Tangerine Road are expected to be less than 100 feet, in order to meet the Town of Oro Valley guidelines, the existing westbound right turn lane at the intersection of Innovation Park Drive/Tangerine Road should be extended for an additional 150 feet east of South Access/Tangerine Road.

Drive-Through Queue Analysis

The proposed coffee shop will provide one drive-through window lane with the entrance located at the northeast corner of the site. Vehicles utilizing either drive-through window lane will travel in a counter-clockwise direction around the building and will exit on the southeast corner. In total, the drive through lane will provide approximately 265 feet of storage for queueing vehicles up to the 'mouth' of the drive through lane and an additional 75 feet of storage within the parking lot without blocking internal access or the intersection of West Access/Tangerine Road.

To determine the service rate for the coffee shop drive-through window lane, research was conducted within transportation professional journals in an attempt to identify information on typical coffee shop vehicle queues. The following two reports capture significant data from similar coffee shops to that being proposed for this site:

1. "New Drive-Through Stacking Information for Banks and Coffee Shops", Mark Stuecheli, PTP, 2009 (Stuecheli Report)
2. "Drive-Through Queue Generation", Mike Spack, PE, PTOE, et al. 2012 (Spack Report)

The Spack Report included fourteen days of data collection at six coffee shop locations in Minnesota from 2010-2012 and twelve days of data from various Kansas locations which were included in the Stuecheli Report. The results of the research have been provided below in **Table 9** and in the attached appendix.

Table 9 – Drive-Through Coffee Shop Maximum Queue Statistics

	Minnesota Data	Missesota + Kansas Data
Number of Data Points	14	26
Average Maximum Queue (Vehicles)	11.00	10.23
Standard Deviation (Vehicles)	2.25	2.76
Coefficient of Variation	20%	27%
Range (Vehilces)	7 to 16	3 to 16
85th Percentile (Vehicles)	13.50	13.00
33rd Percentile (Vehicles)	10.00	9.91

vtpd - vehicle trips per day, vtph - vehicle trips per hour

The recommendations of the two reports state that coffee shops with drive-through window lanes should accommodate a peak queue of thirteen vehicles. This is a 'peak' recommendation and typical queues frequently average between four (4) and eight (8) vehicles. It is also mentioned that coffee shops with drive-through window lanes should provide at least 260 feet of vehicle stacking for the thirteen (13) vehicles, which is calculated using twenty foot spacing per vehicle. The analysis from both reports is based on observed data and represents observation of the maximum queue at full service and drive-through window only Caribou Coffee and Starbucks locations. It is worth mentioning these coffee shops with drive through window locations were located in suburban cities outside of their respective metropolitan regions of Minneapolis, Minnesota and Kansas City, Kansas. While no direct correlation can be made between Minnesota, Kansas and Arizona driver behavior, the willingness to wait in a queue of traffic is expected to be similar between coffee shop consumers across the country. A closer look at the maximum queue data shows that in over 95% of observations, the maximum queue was not over fourteen (14) vehicles long. However, Town of Oro Valley observations at a similar site show a maximum queue can peak at seventeen (17) vehicles. In the event this occurs, an additional 75 feet of queueing space is available within the internal parking lot where it is anticipated to not block traffic entering at West Access or traffic operations at the driveways to the site located along Ina Road and Innovation Park Drive.

Internal Circulation Analysis

The Innovation Starbucks project site will be served by three access points.

The coffee shop will provide one drive through window lane with the entrance to the drive through located on the northeast corner. Vehicles will travel in a counter-clockwise direction around the building and will exit on the southeast corner. The proposed drive through window lane is expected to provide adequate storage for queuing vehicles.

A series of east/west and north/south aligned crosswalk and sidewalks are proposed within the Innovation Starbucks development enabling pedestrians within the site to walk between the establishments. The east/west aligned pedestrian pathway connects West Access, Office 2, and the pedestrian pathway to the east of the project site. The north/south aligned pedestrian pathway connects the coffee shop, high turnover restaurant, office 1, office 3, and North Access. The east/west and north/south pedestrian pathway intersect near the center of the proposed project. Additionally, a multi-use path will be provided on the north side of Tangerine Road between the intersections of Innovation Park Drive and South Access. This new sidewalk will allow pedestrians to walk between the proposed project and the existing sidewalk facilities on Innovation Park Drive and the pedestrian/bike path on the south side of Tangerine Road.

Driveway throat lengths allow entering/exiting vehicles to smoothly transition between the adjacent roads and site without unexpected vehicles turning from internal drive aisles, or parking maneuvers, being located immediately adjacent to the actual driveway transitions. The main drive aisles are intuitive and offer clear paths of travel.

There are no Park and Ride or Public Transit facilities on or near the project site.

Bike lanes are provided on Tangerine Road, Innovation Park Drive, and Vistoso Park Road South.

Conclusion

When fully completed, the proposed Innovation Starbucks project is predicted to generate an additional 2,006 vehicle trips per day (vtpd) on weekdays to the adjacent street system from the new project site. Fifty percent of these new trips (1,003 vehicle trips) will be into the project and fifty percent will be out of the project.

The study intersections of Innovation Park Drive/Tangerine Road, Vistoso Park Road South/Innovation Park Drive, and Orthopedic Driveway/Vistoso Park Road South currently operate at an adequate LOS.

All of the study intersections are expected to operate at an adequate LOS without and with the project in 2024.

While the intersection of West Access/Innovation Park Drive is approximately 45 feet short of typical Oro Valley driveway spacing (330 feet), there is only about 600 feet between Tangerine Road and Vistoso Park Road. Its location in the middle between these two roadways is not expected to impact driver expectations in the area. Furthermore, as a right in/right out only driveway, with a northbound left turn lane, the intersection is expected to operate at an adequate level of service. Moreover, as part of the proposed project, the curb return on the north side of West Access will 'bulb-out' to provide a clear delineation between the northbound right turn lanes at West Access and Vistoso Park Road South along Innovation Park Drive.

An eastbound right turn lane is not warranted at North Access.

The northbound right turning movement at West Access/Innovation Park Drive and the westbound right turning movements at South Access/Tangerine Road and Innovation Park Drive/Tangerine Road are expected to generate queues of 100 feet or less.

The existing westbound right turn lane at the intersection of Innovation Park Drive/Tangerine Road will be extended east to act as a continuous right turn lane serving both intersections of Innovation Park Drive and South Access along Tangerine Road per Town of Oro Valley direction. While the storage requirements for the westbound right turn lane at South Access/Tangerine Road are expected to be less than 50 feet, in order to meet the Town of Oro Valley guidelines, the existing westbound right turn lane at the intersection of Innovation Park Drive/Tangerine Road should be extended for an additional 150 feet east of South Access/Tangerine Road.

Due to the location of West Access/Innovation Park Drive the proposed northbound right turn lane on Innovation Park Drive should be maximized to fit in the available geometry. With the construction of West Access/Innovation Park Drive, the taper for the existing northbound right turn lane at the intersection of Vistoso Park Road South/Innovation Park Drive should be reconstructed to start after the curb return for the proposed northbound right turn lane at the intersection of West Access/Innovation Park Drive.

The reconstructed westbound right turn lanes at Innovation Park Drive/Tangerine Road and South Access/Tangerine Road are expected to provide adequate storage for vehicle queues.

The proposed vehicle storage space for the drive-through window lane at the coffee shop is expected to meet the needs of this establishment. However, Town of Oro Valley observations at a similar site show a maximum queue can peak at seventeen (17) vehicles. In the event this occurs, an additional 75 feet of queueing space is available within the internal parking lot where it is not anticipated to block traffic entering at West Access or traffic operations at the driveways to the site located along Ina Road and Innovation Park Drive.

A series of east/west and north/south aligned crosswalks and sidewalks are proposed within the Innovation Starbucks development enabling pedestrians within the site to walk between the establishments. The east/west aligned pedestrian pathway connects West Access, Office 2, and the pedestrian pathway to the east of the project site. The north/south aligned pedestrian pathway connects the coffee shop, high turnover restaurant, office 1, office 3, and North Access. The east/west and north/south pedestrian pathway intersect near the center of the proposed project. Additionally, a multi-use path will be provided on the north side of Tangerine Road between the intersections of Innovation Park Drive and South Access. This new multi-use path will allow pedestrians to walk between the proposed project and the existing sidewalk facilities on Innovation Park Drive and the pedestrian/bike path on the south side of Tangerine Road.

Driveway throat lengths allow entering/exiting vehicles to smoothly transition between the adjacent roads and site without unexpected vehicles turning from internal drive aisles, or parking maneuvers, being located immediately adjacent to the actual driveway transitions.

The main drive aisles are intuitive and offer clear paths of travel.

The existing westbound right turn lane at the intersection of Innovation Park Drive/Tangerine Road will be extended east to act as a continuous right turn lane serving both intersections of Innovation Park Drive and South Access along Tangerine Road per Town of Oro Valley direction. While the storage requirements for the westbound right turn lane at South Access/Tangerine Road are expected to be less than 100 feet, in order to meet the Town of Oro Valley guidelines, the existing westbound right turn lane at the intersection of Innovation Park Drive/Tangerine Road should be extended for an additional 150 feet east of South Access/Tangerine Road.

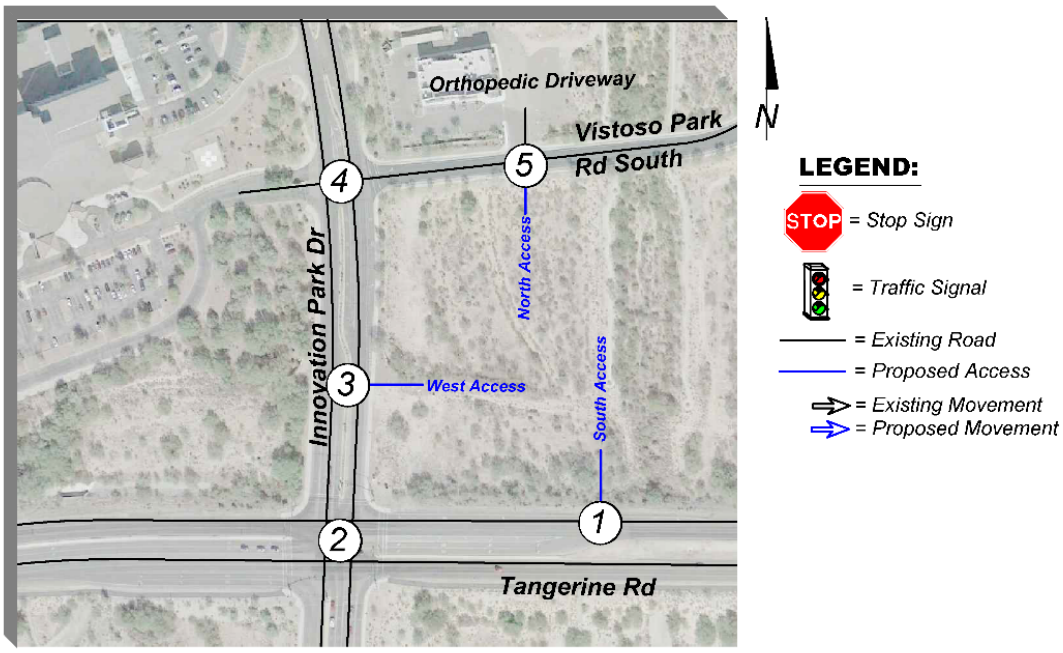
Due to the location of West Access/Innovation Park Drive the proposed northbound right turn lane on Innovation Park Drive should be maximized to fit in the available geometry.

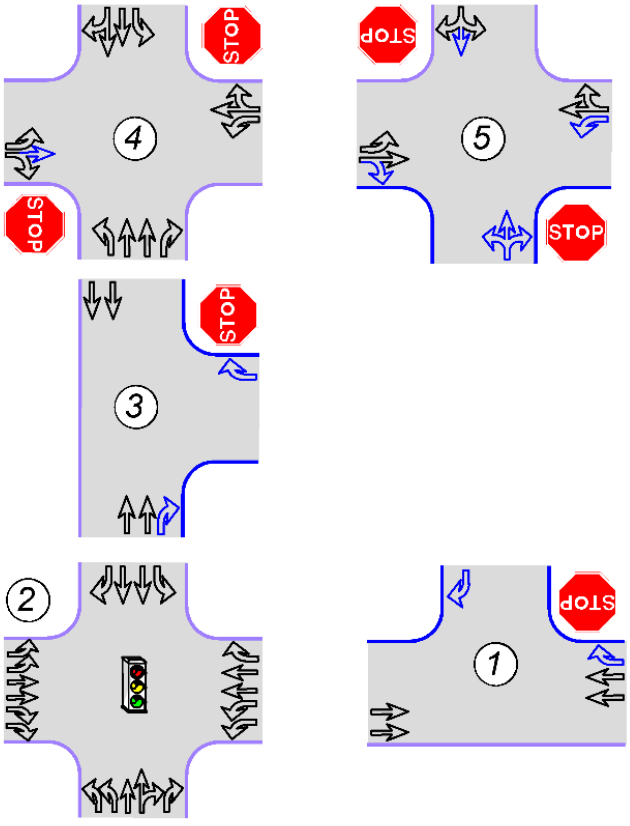
With the construction of West Access/Innovation Park Drive, the taper for the existing northbound right turn lane at the intersection of Vistoso Park Road South/Innovation Park Drive should be reconstructed to start after the curb return for the proposed northbound right turn lane at the intersection of West Access/Innovation Park Drive.

The eastbound right turn lane at the intersection of Vistoso Park Road South/Innovation Park Drive should be restriped as a shared through/right turn lane.

Proposed lane configurations and traffic control are shown in **Figure 11**.

Figure 11 – Proposed Lane Configurations and Traffic Control





INNOVATION STARBUCKS
INNOVATION PARK DRIVE/TANGERINE ROAD
REVISED TRAFFIC IMPACT ANALYSIS

APPENDIX

Traffic Counts

Trip Generation Calculations

Capacity Calculations

Turn Lane Calculations

Spack Report

Comment Resolution

INNOVATION STARBUCKS
INNOVATION PARK DRIVE/TANGERINE ROAD
REVISED TRAFFIC IMPACT ANALYSIS

APPENDIX

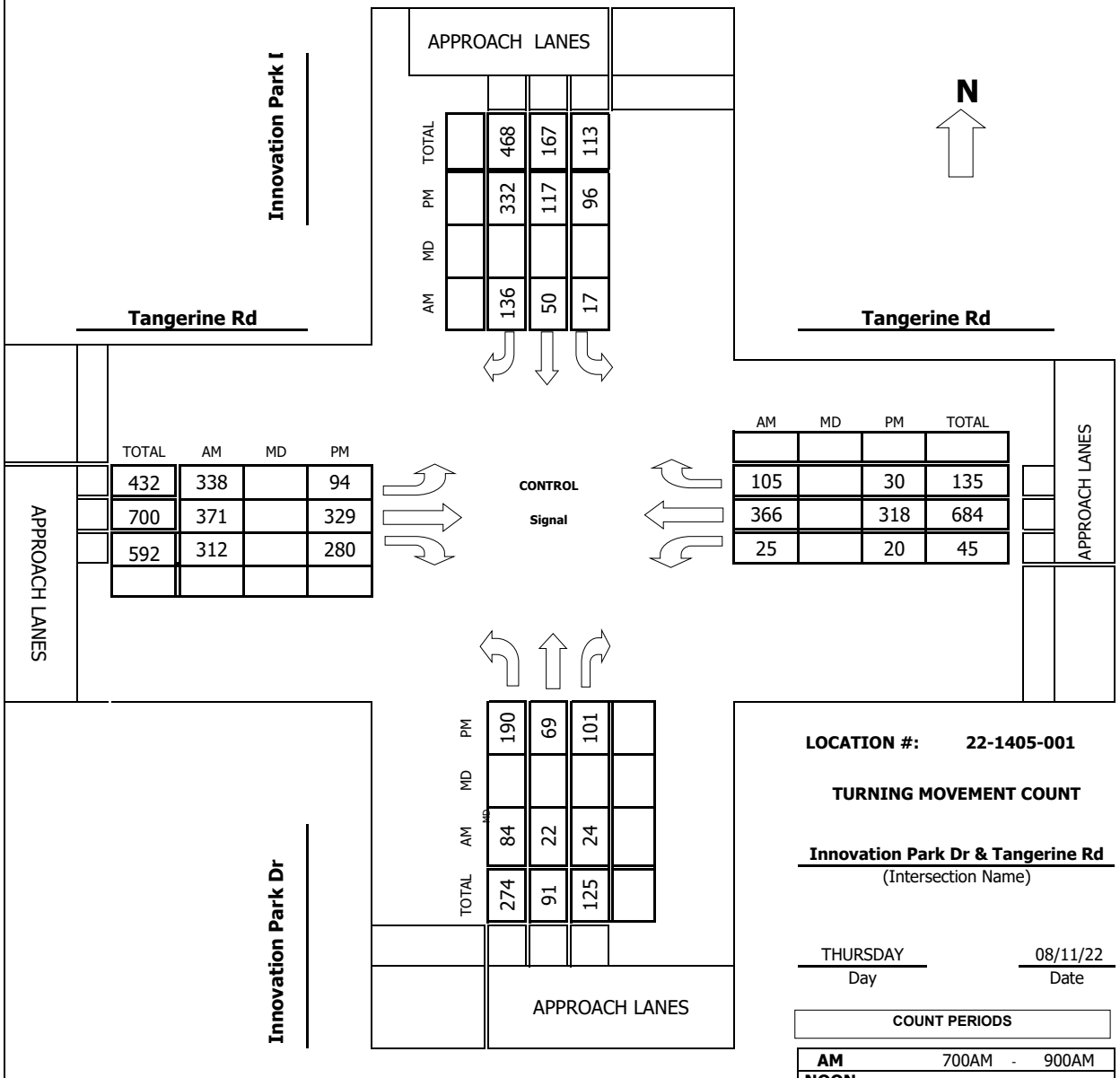
Traffic Counts

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 22-1405-001

TMC SUMMARY OF Innovation Park Dr & Tangerine Rd



LOCATION #: 22-1405-001

TURNING MOVEMENT COUNT

Innovation Park Dr & Tangerine Rd
(Intersection Name)

THURSDAY (Day) 08/11/22 (Date)

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 715 AM

NOON PEAK HOUR

PM PEAK HOUR 400 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Innovation Park Dr	DATE:	08/11/22	LOCATION:	Oro Valley
E-W STREET:	Tangerine Rd	DAY:	THURSDAY	PROJECT#	22-1405-001

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	1.5	1.5	1	2	1	2	2	2	2	2	1	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	19	2	4	3	9	17	56	66	88	5	87	33	389
7:15 AM	15	3	7	6	11	15	94	96	80	8	85	29	449
7:30 AM	20	6	4	2	10	40	91	103	74	5	86	24	465
7:45 AM	24	5	8	5	14	39	80	96	78	6	96	28	479
8:00 AM	25	8	5	4	15	42	73	76	80	6	99	24	457
8:15 AM	20	4	9	7	13	34	87	74	54	9	90	20	421
8:30 AM	22	7	6	5	11	32	91	80	41	5	85	16	401
8:45 AM	19	8	6	8	7	46	73	88	43	2	74	19	393
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	164	43	49	40	90	265	645	679	538	46	702	193	3454
Approach %	64.06	16.80	19.14	10.13	22.78	67.09	34.64	36.47	28.89	4.89	74.60	20.51	
App/Depart	256	/	881	395	/	674	1862	/	768	941	/	1131	

AM Peak Hr Begins at: 715 AM

PEAK													
Volumes	84	22	24	17	50	136	338	371	312	25	366	105	1850
Approach %	64.62	16.92	18.46	8.37	24.63	67.00	33.10	36.34	30.56	5.04	73.79	21.17	
PEAK HR. FACTOR:		0.855			0.832			0.945			0.954		0.966

CONTROL: Signal
COMMENT 1:
GPS: 32.427197, -110.946871

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Innovation Park Dr 0	DATE:	08/11/22	LOCATION:	Oro Valley
E-W STREET:	Tangerine Rd	DAY:	THURSDAY	PROJECT#	22-1405-001

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	1.5	1.5	1	2	1	2	2	2	2	2	1	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	41	16	22	22	28	83	30	86	69	5	88	9	499
4:15 PM	45	18	24	25	27	83	28	85	66	8	80	6	495
4:30 PM	50	14	28	24	29	93	16	80	60	5	74	6	479
4:45 PM	54	21	27	25	33	73	20	78	85	2	76	9	503
5:00 PM	58	20	29	21	30	75	31	74	74	3	69	5	489
5:15 PM	59	16	33	20	32	80	24	80	75	6	60	8	493
5:30 PM	66	16	30	16	36	83	10	66	74	9	65	2	473
5:45 PM	60	18	32	19	33	62	10	63	76	6	58	5	442
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	433	139	225	172	248	632	169	612	579	44	570	50	3873
Approach %	54.33	17.44	28.23	16.35	23.57	60.08	12.43	45.00	42.57	6.63	85.84	7.53	
App/Depart	797	/	358	1052	/	871	1360	/	1009	664	/	1635	

PM Peak Hr Begins at: 400 PM

PEAK													
Volumes	190	69	101	96	117	332	94	329	280	20	318	30	1976
Approach %	52.78	19.17	28.06	17.61	21.47	60.92	13.37	46.80	39.83	5.43	86.41	8.15	
PEAK HR. FACTOR:		0.882			0.933			0.950			0.902		0.982

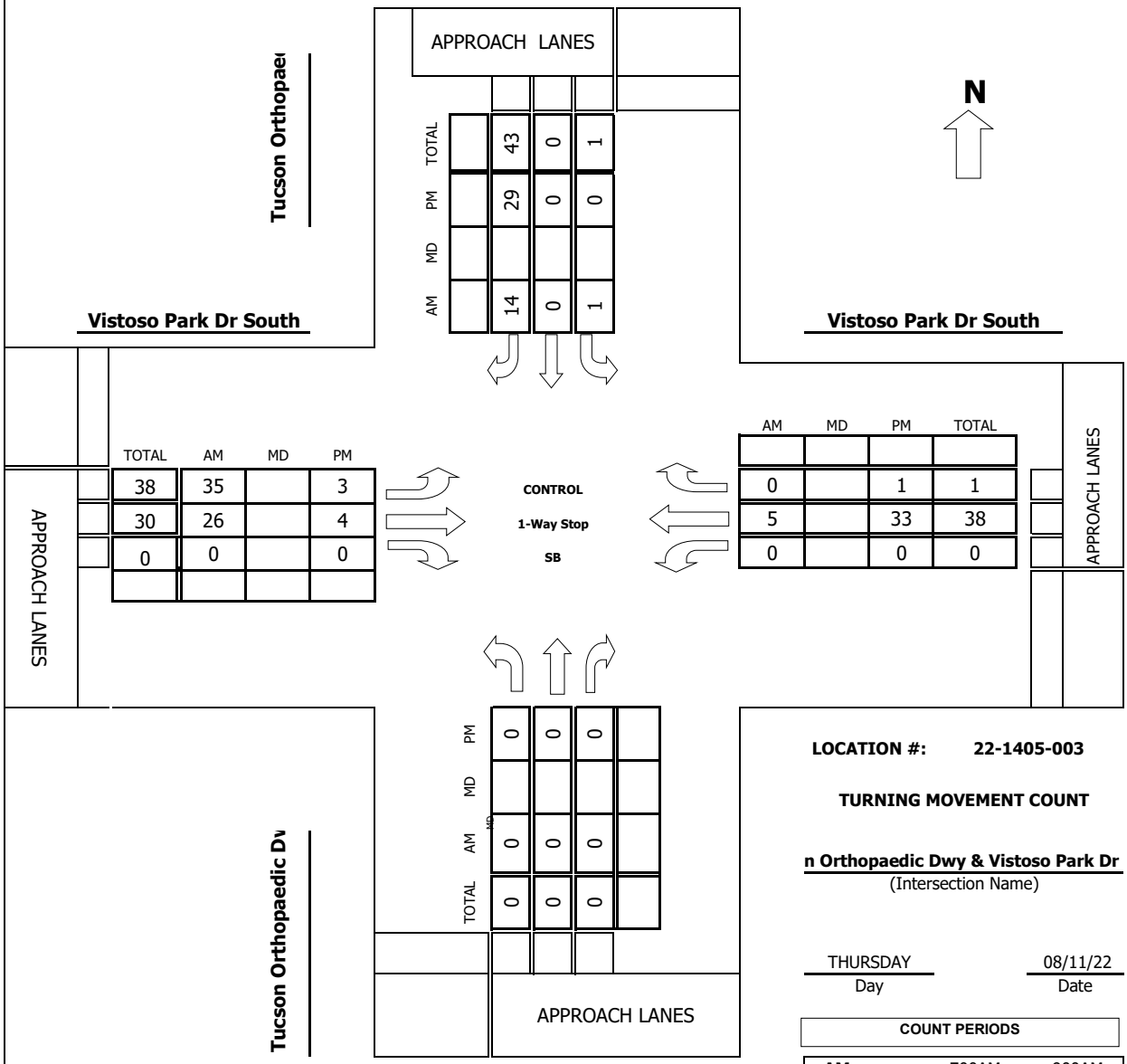
CONTROL:	Signal
COMMENT 1:	0
GPS:	32.427197, -110.946871

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 22-1405-003

TMC SUMMARY OF Tucson Orthopaedic Dwy & Vistoso Park Dr South



LOCATION #: 22-1405-003

TURNING MOVEMENT COUNT

n Orthopaedic Dwy & Vistoso Park Dr
(Intersection Name)

THURSDAY — Day
08/11/22 — Date

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 745 AM

NOON PEAK HOUR

PM PEAK HOUR 400 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Tucson Orthopaedic Dwy	DATE:	08/11/22	LOCATION:	Oro Valley
E-W STREET:	Vistoso Park Dr South	DAY:	THURSDAY	PROJECT#	22-1405-003

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	0	0	1	0	0	1	0	0	1	0	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	0	0	0	0	0	0	5	4	0	0	1	0	10
7:15 AM	0	0	0	0	0	0	6	6	0	0	1	0	13
7:30 AM	0	0	0	0	0	0	7	7	0	0	0	0	14
7:45 AM	0	0	0	0	0	1	9	8	0	0	1	0	19
8:00 AM	0	0	0	0	0	6	10	8	0	0	1	0	25
8:15 AM	0	0	0	0	0	6	8	7	0	0	2	0	23
8:30 AM	0	0	0	1	0	1	8	3	0	0	1	0	14
8:45 AM	0	0	0	0	0	5	2	0	0	0	1	0	8
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	0	0	0	1	0	19	55	43	0	0	8	0	126
Approach %	####	####	####	5.00	0.00	95.00	56.12	43.88	0.00	0.00	100.00	0.00	
App/Depart	0	/	55	20	/	0	98	/	44	8	/	27	

AM Peak Hr Begins at: 745 AM

PEAK													
Volumes	0	0	0	1	0	14	35	26	0	0	5	0	81
Approach %	####	####	####	6.67	0.00	93.33	57.38	42.62	0.00	0.00	100.00	0.00	

PEAK HR. FACTOR:	0.000	0.625	0.847	0.625	0.810

CONTROL: 1-Way Stop (SB)
COMMENT 1:
GPS: 32.429243, -110.945717

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Tucson Orthopaedic Dwy 0	DATE:	08/11/22	LOCATION:	Oro Valley
E-W STREET:	Vistoso Park Dr South	DAY:	THURSDAY	PROJECT#	22-1405-003

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	0	0	1	0	0	1	0	0	1	0	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	0	0	0	0	0	8	2	1	0	0	7	1	19
4:15 PM	0	0	0	0	0	9	1	0	0	0	5	0	15
4:30 PM	0	0	0	0	0	5	0	1	0	0	9	0	15
4:45 PM	0	0	0	0	0	7	0	2	0	0	12	0	21
5:00 PM	0	0	0	0	0	6	0	2	0	0	9	0	17
5:15 PM	0	0	0	0	0	2	0	1	0	0	11	0	14
5:30 PM	0	0	0	0	0	1	0	0	0	0	11	0	12
5:45 PM	0	0	0	0	0	0	0	1	0	0	5	0	6
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	0	0	0	0	0	38	3	8	0	0	69	1	119
Approach %	####	####	####	0.00	0.00	100.00	27.27	72.73	0.00	0.00	98.57	1.43	
App/Depart	0	/	4	38	/	0	11	/	8	70	/	107	

PM Peak Hr Begins at: 400 PM

PEAK													
Volumes	0	0	0	0	0	29	3	4	0	0	33	1	70
Approach %	####	####	####	0.00	0.00	100.00	42.86	57.14	0.00	0.00	97.06	2.94	

PEAK HR. FACTOR:	0.000	0.806	0.583	0.708	0.833

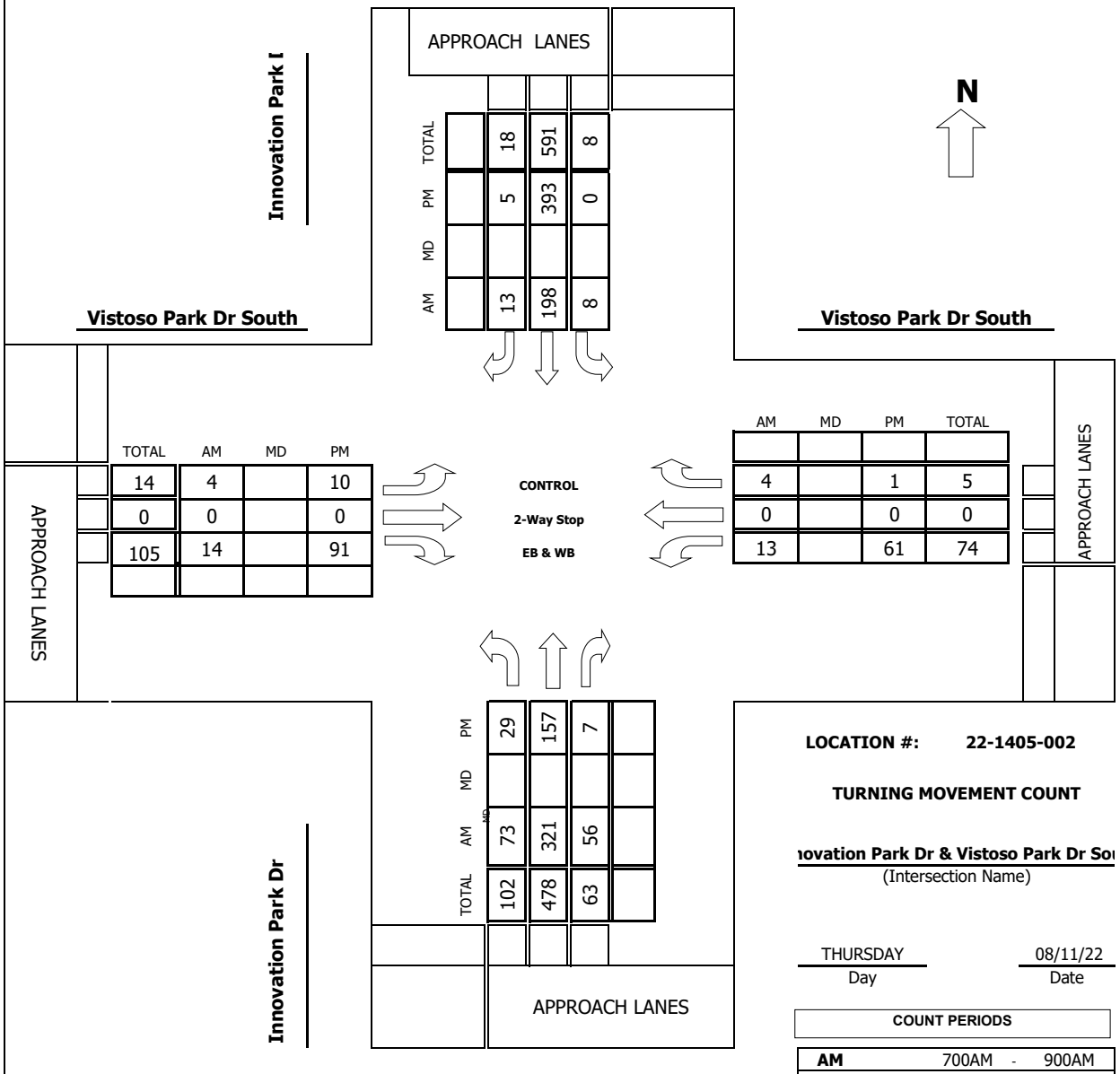
CONTROL:	1-Way Stop (SB)
COMMENT 1:	0
GPS:	32.429243, -110.945717

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 22-1405-002

TMC SUMMARY OF Innovation Park Dr & Vistoso Park Dr South



LOCATION #: 22-1405-002

TURNING MOVEMENT COUNT

ıovation Park Dr & Vistoso Park Dr Sou
(Intersection Name)

THURSDAY — Day
08/11/22 — Date

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 730 AM

NOON PEAK HOUR

PM PEAK HOUR 400 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Innovation Park Dr	DATE:	08/11/22	LOCATION:	Oro Valley
E-W STREET:	Vistoso Park Dr South	DAY:	THURSDAY	PROJECT#	22-1405-002

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	1	1	2	0	1	0	1	1	0.5	0.5	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	14	69	8	1	29	2	1	0	0	0	0	1	125
7:15 AM	19	96	11	1	30	5	0	0	1	1	0	0	164
7:30 AM	20	89	12	2	52	2	1	0	0	0	0	0	178
7:45 AM	21	78	14	3	55	3	0	0	2	1	0	1	178
8:00 AM	14	74	17	1	50	6	1	0	6	5	0	2	176
8:15 AM	18	80	13	2	41	2	2	0	6	7	0	1	172
8:30 AM	16	88	10	1	45	5	1	0	1	2	0	0	169
8:45 AM	13	85	2	0	50	2	0	0	6	5	0	1	164
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	135	659	87	11	352	27	6	0	22	21	0	6	1326
Approach %	15.32	74.80	9.88	2.82	90.26	6.92	21.43	0.00	78.57	77.78	0.00	22.22	
App/Depart	881	/	671	390	/	395	28	/	98	27	/	162	

AM Peak Hr Begins at: 730 AM

PEAK													
Volumes	73	321	56	8	198	13	4	0	14	13	0	4	704
Approach %	16.22	71.33	12.44	3.65	90.41	5.94	22.22	0.00	77.78	76.47	0.00	23.53	
PEAK HR. FACTOR:	0.930			0.898			0.563			0.531			0.989

CONTROL:	2-Way Stop (EB & WB)
COMMENT 1:	
GPS:	32.429138, -110.946830

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Innovation Park Dr 0	DATE:	08/11/22	LOCATION:	Oro Valley
E-W STREET:	Vistoso Park Dr South	DAY:	THURSDAY	PROJECT#	22-1405-002

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	1	1	2	0	1	0	1	1	0.5	0.5	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	7	45	3	0	99	1	1	0	19	15	0	0	190
4:15 PM	8	43	1	0	101	1	3	0	20	14	0	0	191
4:30 PM	5	30	1	0	108	2	2	0	24	14	0	0	186
4:45 PM	9	39	2	0	85	1	4	0	28	18	0	1	187
5:00 PM	11	43	2	0	89	0	1	0	22	15	0	0	183
5:15 PM	7	41	0	1	99	1	2	0	20	13	0	0	184
5:30 PM	4	24	0	0	103	2	1	0	21	11	0	1	167
5:45 PM	5	28	0	1	96	1	1	0	14	4	0	1	151
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	56	293	9	2	780	9	15	0	168	104	0	3	1439
Approach %	15.64	81.84	2.51	0.25	98.61	1.14	8.20	0.00	91.80	97.20	0.00	2.80	
App/Depart	358	/	311	791	/	1052	183	/	11	107	/	65	

PM Peak Hr Begins at: 400 PM

PEAK													
Volumes	29	157	7	0	393	5	10	0	91	61	0	1	754
Approach %	15.03	81.35	3.63	0.00	98.74	1.26	9.90	0.00	90.10	98.39	0.00	1.61	

PEAK HR. FACTOR:	0.877	0.905	0.789	0.816	0.987

CONTROL:	2-Way Stop (EB & WB)
COMMENT 1:	0
GPS:	32.429138, -110.946830

INNOVATION STARBUCKS
INNOVATION PARK DRIVE/TANGERINE ROAD
REVISED TRAFFIC IMPACT ANALYSIS

APPENDIX

Trip Generation Calculations

Coffee/Donut Shop with Drive-Through Window

LAND USE: 2,400 Square Feet Coffee/Donut Shop with Drive-Through Window

TRIP GENERATION CALCULATIONS ARE BASED ON THE INSTITUTE OF TRANSPORTATION ENGINEERS' TRIP GENERATION, 11TH EDITION. THE ITE LAND USE CODE IS Coffee/Donut Shop with Drive-Through Window (937), General Urban/Suburban

WEEKDAY

Average Rate = 533.57 Trips per 1000 Square Feet (Sq Ft.)

T = 533.57 Trips x 2400 Sq Ft. / 1000

T = 1,282 VTPD

ENTER: (0.5)*(1282) = **641 VTPD**

EXIT: (0.5)*(1282) = **641 VTPD**

AM PEAK HOUR (ONE HOUR BETWEEN 7 AND 9 AM)

Average Rate = 85.88 Trips per 1000 Square Feet (Sq Ft.)

T = 85.88 Trips x 2400 Sq Ft. / 1000

T = 207 VPH

ENTER: (0.51)*(207) = **106 VPH**

EXIT: (0.49)*(207) = **101 VPH**

PM PEAK HOUR (ONE HOUR BETWEEN 4 AND 6 PM)

Average Rate = 38.99 Trips per 1000 Square Feet (Sq Ft.)

T = 38.99 Trips x 2400 Sq Ft. / 1000

T = 94 VPH

ENTER: (0.5)*(94) = **47 VPH**

EXIT: (0.5)*(94) = **47 VPH**

*where, T = trip ends

TRIP GENERATION SUMMARY

WEEKDAY	**1,282 VTPD**
AM PEAK HOUR (ONE HOUR BETWEEN 7 AND 9 AM)	**207 VPH**
PM PEAK HOUR (ONE HOUR BETWEEN 4 AND 6 PM)	**94 VPH**

High-Turnover (Sit-Down) Restaurant

LAND USE: 4,000 Square Feet High-Turnover (Sit-Down) Restaurant

TRIP GENERATION CALCULATIONS ARE BASED ON THE INSTITUTE OF TRANSPORTATION ENGINEERS' TRIP GENERATION, 11TH EDITION. THE ITE LAND USE CODE IS High-Turnover (Sit-Down) Restaurant (932), General Urban/Suburban

WEEKDAY

Average Rate = 107.2 Trips per 1000 Square Feet (Sq Ft.)

T = 107.2 Trips x 4000 Sq Ft. / 1000

T = 430 VTPD

ENTER: (0.5)*(430) = **215 VTPD**

EXIT: (0.5)*(430) = **215 VTPD**

AM PEAK HOUR (ONE HOUR BETWEEN 7 AND 9 AM)

Average Rate = 9.57 Trips per 1000 Square Feet (Sq Ft.)

T = 9.57 Trips x 4000 Sq Ft. / 1000

T = 39 VPH

ENTER: (0.55)*(39) = **21 VPH**

EXIT: (0.45)*(39) = **18 VPH**

PM PEAK HOUR (ONE HOUR BETWEEN 4 AND 6 PM)

Average Rate = 9.05 Trips per 1000 Square Feet (Sq Ft.)

T = 9.05 Trips x 4000 Sq Ft. / 1000

T = 37 VPH

ENTER: (0.61)*(37) = **23 VPH**

EXIT: (0.39)*(37) = **14 VPH**

*where, T = trip ends

TRIP GENERATION SUMMARY

WEEKDAY	**430 VTPD**
AM PEAK HOUR (ONE HOUR BETWEEN 7 AND 9 AM)	**39 VPH**
PM PEAK HOUR (ONE HOUR BETWEEN 4 AND 6 PM)	**37 VPH**

General Office Building

LAND USE: 27,000 Square Feet General Office Building

TRIP GENERATION CALCULATIONS ARE BASED ON THE INSTITUTE OF TRANSPORTATION ENGINEERS' TRIP GENERATION, 11TH EDITION. THE ITE LAND USE CODE IS General Office Building (710), General Urban/Suburban

WEEKDAY

Average Rate = 10.84 Trips per 1000 Square Feet (Sq Ft.)

T = 10.84 Trips x 27000 Sq Ft. / 1000

T = 294 VTPD

ENTER: (0.5)*(294) = **147 VTPD**

EXIT: (0.5)*(294) = **147 VTPD**

AM PEAK HOUR (ONE HOUR BETWEEN 7 AND 9 AM)

Average Rate = 1.52 Trips per 1000 Square Feet (Sq Ft.)

T = 1.52 Trips x 27000 Sq Ft. / 1000

T = 42 VPH

ENTER: (0.88)*(42) = **37 VPH**

EXIT: (0.12)*(42) = **5 VPH**

PM PEAK HOUR (ONE HOUR BETWEEN 4 AND 6 PM)

Average Rate = 1.44 Trips per 1000 Square Feet (Sq Ft.)

T = 1.44 Trips x 27000 Sq Ft. / 1000

T = 39 VPH

ENTER: (0.17)*(39) = **7 VPH**

EXIT: (0.83)*(39) = **32 VPH**

*where, T = trip ends

TRIP GENERATION SUMMARY

WEEKDAY	**294 VTPD**
AM PEAK HOUR (ONE HOUR BETWEEN 7 AND 9 AM)	**42 VPH**
PM PEAK HOUR (ONE HOUR BETWEEN 4 AND 6 PM)	**39 VPH**

INNOVATION STARBUCKS
INNOVATION PARK DRIVE/TANGERINE ROAD
REVISED TRAFFIC IMPACT ANALYSIS

APPENDIX

Capacity Calculations

Intersection	
Int Delay, s/veh	1.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	0	14	13	0	4	73	321	56	8	198	13
Future Vol, veh/h	4	0	14	13	0	4	73	321	56	8	198	13
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	0	-	-	0	-	0	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	80	80	80	80	80	80	85	90	80	80	85	80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	0	18	16	0	5	86	357	70	10	233	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	612	860	125	666	798	179	249	0	0	427	0	0
Stage 1	261	261	-	529	529	-	-	-	-	-	-	-
Stage 2	351	599	-	137	269	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	377	292	902	345	317	833	1314	-	-	1129	-	-
Stage 1	721	691	-	501	525	-	-	-	-	-	-	-
Stage 2	639	489	-	852	685	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	354	271	902	319	294	833	1314	-	-	1129	-	-
Mov Cap-2 Maneuver	354	271	-	319	294	-	-	-	-	-	-	-
Stage 1	674	685	-	468	491	-	-	-	-	-	-	-
Stage 2	594	457	-	828	679	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.5	15.1	1.3	0.3
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1314	-	-	354	902	319	833	1129	-	-
HCM Lane V/C Ratio	0.065	-	-	0.014	0.019	0.051	0.006	0.009	-	-
HCM Control Delay (s)	7.9	-	-	15.3	9.1	16.9	9.3	8.2	-	-
HCM Lane LOS	A	-	-	C	A	C	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0	0.1	0.2	0	0	-	-

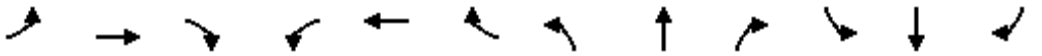
Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	35	26	5	0	1	14
Future Vol, veh/h	35	26	5	0	1	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	80	80	80	80	80	80
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	44	33	6	0	1	18

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	6	0	-	0	127	6
Stage 1	-	-	-	-	6	-
Stage 2	-	-	-	-	121	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1615	-	-	-	868	1077
Stage 1	-	-	-	-	1017	-
Stage 2	-	-	-	-	904	-
Platoon blocked, %			-	-	-	
Mov Cap-1 Maneuver	1615	-	-	-	845	1077
Mov Cap-2 Maneuver	-	-	-	-	845	-
Stage 1	-	-	-	-	990	-
Stage 2	-	-	-	-	904	-

Approach	EB	WB	SB
HCM Control Delay, s	4.2	0	8.5
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1615	-	-	-	1058
HCM Lane V/C Ratio	0.027	-	-	-	0.018
HCM Control Delay (s)	7.3	-	-	-	8.5
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0.1	-	-	-	0.1



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	338	371	312	25	366	105	84	22	24	17	50	136
Future Volume (vph)	338	371	312	25	366	105	84	22	24	17	50	136
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.97	0.95	0.88	0.97	0.95	1.00	0.97	0.91	0.91	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	2787	3433	3539	1583	3433	3238	1441	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	2787	3433	3539	1583	3433	3238	1441	1770	3539	1583
Peak-hour factor, PHF	0.90	0.90	0.90	0.80	0.90	0.85	0.85	0.80	0.80	0.80	0.80	0.85
Adj. Flow (vph)	376	412	347	31	407	124	99	28	30	21	62	160
RTOR Reduction (vph)	0	0	221	0	0	97	0	8	11	0	0	108
Lane Group Flow (vph)	376	412	126	31	407	27	99	32	7	21	63	52
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	13.6	29.6	29.6	1.9	17.9	17.9	5.5	29.4	29.4	2.3	26.2	26.2
Effective Green, g (s)	13.6	29.6	29.6	1.9	17.9	17.9	5.5	29.4	29.4	2.3	26.2	26.2
Actuated g/C Ratio	0.17	0.36	0.36	0.02	0.22	0.22	0.07	0.36	0.36	0.03	0.32	0.32
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	574	1290	1015	80	780	348	232	1172	521	50	1141	510
v/s Ratio Prot	c0.11	0.12		0.01	c0.11		c0.03	c0.01		0.01	0.02	
v/s Ratio Perm			0.05			0.02			0.00			c0.03
v/c Ratio	0.66	0.32	0.12	0.39	0.52	0.08	0.43	0.03	0.01	0.42	0.06	0.10
Uniform Delay, d1	31.6	18.6	17.2	39.1	27.9	25.1	36.3	16.7	16.6	38.8	19.0	19.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.7	0.1	0.1	3.1	0.6	0.1	1.3	0.0	0.0	5.6	0.1	0.4
Delay (s)	34.3	18.7	17.2	42.2	28.5	25.2	37.6	16.7	16.6	44.4	19.1	19.7
Level of Service	C	B	B	D	C	C	D	B	B	D	B	B
Approach Delay (s)		23.4			28.5			29.9			21.6	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	81.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	40.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	3.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	0	91	61	0	1	29	157	7	8	393	5
Future Vol, veh/h	10	0	91	61	0	1	29	157	7	8	393	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	0	-	-	0	-	0	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	80	80	80	85	80	80	80	85	80	80	90	80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	13	0	114	72	0	1	36	185	9	10	437	6

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	625	726	222	496	720	93	443	0	0	194	0	0
Stage 1	460	460	-	257	257	-	-	-	-	-	-	-
Stage 2	165	266	-	239	463	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	369	350	782	457	352	946	1113	-	-	1377	-	-
Stage 1	551	564	-	725	694	-	-	-	-	-	-	-
Stage 2	821	687	-	743	562	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	358	336	782	379	338	946	1113	-	-	1377	-	-
Mov Cap-2 Maneuver	358	336	-	379	338	-	-	-	-	-	-	-
Stage 1	533	560	-	702	672	-	-	-	-	-	-	-
Stage 2	793	665	-	630	558	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.9	16.6	1.3	0.2
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1113	-	-	358	782	379	946	1377	-	-
HCM Lane V/C Ratio	0.033	-	-	0.035	0.145	0.189	0.001	0.007	-	-
HCM Control Delay (s)	8.3	-	-	15.4	10.4	16.7	8.8	7.6	-	-
HCM Lane LOS	A	-	-	C	B	C	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.1	0.5	0.7	0	0	-	-

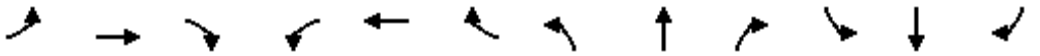
Intersection	
Int Delay, s/veh	3.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	3	4	33	1	0	29
Future Vol, veh/h	3	4	33	1	0	29
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	80	80	80	80	80	80
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	4	5	41	1	0	36

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	42	0	-	0	55	42
Stage 1	-	-	-	-	42	-
Stage 2	-	-	-	-	13	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1567	-	-	-	953	1029
Stage 1	-	-	-	-	980	-
Stage 2	-	-	-	-	1010	-
Platoon blocked, %			-	-	-	
Mov Cap-1 Maneuver	1567	-	-	-	950	1029
Mov Cap-2 Maneuver	-	-	-	-	950	-
Stage 1	-	-	-	-	977	-
Stage 2	-	-	-	-	1010	-

Approach	EB	WB	SB
HCM Control Delay, s	3.1	0	8.6
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1567	-	-	-	1029
HCM Lane V/C Ratio	0.002	-	-	-	0.035
HCM Control Delay (s)	7.3	-	-	-	8.6
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	94	329	280	20	318	30	190	69	101	96	117	332
Future Volume (vph)	94	329	280	20	318	30	190	69	101	96	117	332
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.97	0.95	0.88	0.97	0.95	1.00	0.97	0.91	0.91	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	2787	3433	3539	1583	3433	3182	1441	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	2787	3433	3539	1583	3433	3182	1441	1770	3539	1583
Peak-hour factor, PHF	0.85	0.90	0.85	0.80	0.90	0.80	0.85	0.85	0.85	0.85	0.85	0.90
Adj. Flow (vph)	111	366	329	25	353	38	224	81	119	113	138	369
RTOR Reduction (vph)	0	0	253	0	0	31	0	32	36	0	0	163
Lane Group Flow (vph)	111	366	76	25	353	7	224	105	27	113	138	206
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	5.6	19.1	19.1	2.0	15.5	15.5	10.2	34.8	34.8	8.7	33.3	33.3
Effective Green, g (s)	5.6	19.1	19.1	2.0	15.5	15.5	10.2	34.8	34.8	8.7	33.3	33.3
Actuated g/C Ratio	0.07	0.23	0.23	0.02	0.19	0.19	0.12	0.42	0.42	0.11	0.40	0.40
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	232	818	644	83	664	297	423	1340	607	186	1426	638
v/s Ratio Prot	c0.03	c0.10		0.01	c0.10		c0.07	0.03		0.06	0.04	
v/s Ratio Perm			0.03			0.00			0.02			c0.13
v/c Ratio	0.48	0.45	0.12	0.30	0.53	0.02	0.53	0.08	0.04	0.61	0.10	0.32
Uniform Delay, d1	37.1	27.2	25.1	39.6	30.3	27.4	33.9	14.3	14.1	35.3	15.3	16.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.6	0.4	0.1	2.0	0.8	0.0	1.2	0.1	0.1	5.5	0.1	1.3
Delay (s)	38.6	27.6	25.2	41.7	31.1	27.4	35.2	14.4	14.2	40.8	15.4	18.3
Level of Service	D	C	C	D	C	C	D	B	B	D	B	B
Approach Delay (s)		28.1			31.4			25.3			21.7	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	82.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	1.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	0	15	13	0	4	76	334	58	8	206	14
Future Vol, veh/h	4	0	15	13	0	4	76	334	58	8	206	14
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	0	-	-	0	-	0	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	80	80	80	80	80	80	85	90	80	80	85	80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	0	19	16	0	5	89	371	73	10	242	18

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	635	893	130	690	829	186	260	0	0	444	0	0
Stage 1	271	271	-	549	549	-	-	-	-	-	-	-
Stage 2	364	622	-	141	280	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	363	279	896	331	305	824	1302	-	-	1112	-	-
Stage 1	712	684	-	488	515	-	-	-	-	-	-	-
Stage 2	627	477	-	847	678	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	340	258	896	305	282	824	1302	-	-	1112	-	-
Mov Cap-2 Maneuver	340	258	-	305	282	-	-	-	-	-	-	-
Stage 1	664	678	-	455	480	-	-	-	-	-	-	-
Stage 2	581	445	-	822	672	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.5	15.6	1.3	0.3
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1302	-	-	340	896	305	824	1112	-	-
HCM Lane V/C Ratio	0.069	-	-	0.015	0.021	0.053	0.006	0.009	-	-
HCM Control Delay (s)	8	-	-	15.7	9.1	17.5	9.4	8.3	-	-
HCM Lane LOS	A	-	-	C	A	C	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0	0.1	0.2	0	0	-	-

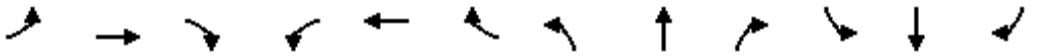
Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	36	27	5	0	1	15
Future Vol, veh/h	36	27	5	0	1	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	80	80	80	80	80	80
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	45	34	6	0	1	19

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	6	0	-	0	130	6
Stage 1	-	-	-	-	6	-
Stage 2	-	-	-	-	124	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1615	-	-	-	864	1077
Stage 1	-	-	-	-	1017	-
Stage 2	-	-	-	-	902	-
Platoon blocked, %			-	-	-	
Mov Cap-1 Maneuver	1615	-	-	-	840	1077
Mov Cap-2 Maneuver	-	-	-	-	840	-
Stage 1	-	-	-	-	989	-
Stage 2	-	-	-	-	902	-

Approach	EB	WB	SB
HCM Control Delay, s	4.2	0	8.5
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1615	-	-	-	1058
HCM Lane V/C Ratio	0.028	-	-	-	0.019
HCM Control Delay (s)	7.3	-	-	-	8.5
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0.1	-	-	-	0.1



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	352	386	325	26	381	109	87	23	25	18	52	141
Future Volume (vph)	352	386	325	26	381	109	87	23	25	18	52	141
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.97	0.95	0.88	0.97	0.95	1.00	0.97	0.91	0.91	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	2787	3433	3539	1583	3433	3241	1441	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	2787	3433	3539	1583	3433	3241	1441	1770	3539	1583
Peak-hour factor, PHF	0.90	0.90	0.90	0.80	0.90	0.85	0.85	0.80	0.80	0.80	0.80	0.85
Adj. Flow (vph)	391	429	361	32	423	128	102	29	31	22	65	166
RTOR Reduction (vph)	0	0	227	0	0	100	0	8	12	0	0	113
Lane Group Flow (vph)	391	429	134	33	423	28	102	33	7	23	65	53
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	14.0	30.3	30.3	1.9	18.2	18.2	5.5	29.4	29.4	2.3	26.2	26.2
Effective Green, g (s)	14.0	30.3	30.3	1.9	18.2	18.2	5.5	29.4	29.4	2.3	26.2	26.2
Actuated g/C Ratio	0.17	0.37	0.37	0.02	0.22	0.22	0.07	0.36	0.36	0.03	0.32	0.32
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	586	1309	1031	79	786	351	230	1163	517	49	1132	506
v/s Ratio Prot	c0.11	0.12		0.01	c0.12		c0.03	c0.01		0.01	0.02	
v/s Ratio Perm			0.05			0.02			0.00			c0.03
v/c Ratio	0.67	0.33	0.13	0.42	0.54	0.08	0.44	0.03	0.01	0.47	0.06	0.10
Uniform Delay, d1	31.8	18.5	17.1	39.5	28.1	25.2	36.7	17.0	16.9	39.2	19.3	19.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.9	0.1	0.1	3.5	0.7	0.1	1.4	0.0	0.0	6.9	0.1	0.4
Delay (s)	34.6	18.6	17.1	43.0	28.8	25.3	38.1	17.0	17.0	46.1	19.4	20.0
Level of Service	C	B	B	D	C	C	D	B	B	D	B	C
Approach Delay (s)		23.5			28.9			30.3			22.2	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	81.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	41.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	3.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	0	95	63	0	1	30	163	7	8	409	5
Future Vol, veh/h	10	0	95	63	0	1	30	163	7	8	409	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	0	-	-	0	-	0	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	80	80	80	85	80	80	80	85	80	80	90	80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	13	0	119	74	0	1	38	192	9	10	454	6

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	649	754	230	515	748	96	460	0	0	201	0	0
Stage 1	477	477	-	268	268	-	-	-	-	-	-	-
Stage 2	172	277	-	247	480	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	355	337	772	443	339	942	1097	-	-	1368	-	-
Stage 1	538	554	-	714	686	-	-	-	-	-	-	-
Stage 2	813	680	-	735	553	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	343	323	772	363	325	942	1097	-	-	1368	-	-
Mov Cap-2 Maneuver	343	323	-	363	325	-	-	-	-	-	-	-
Stage 1	519	550	-	689	662	-	-	-	-	-	-	-
Stage 2	784	656	-	617	549	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	11	17.3	1.3	0.2
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1097	-	-	343	772	363	942	1368	-	-
HCM Lane V/C Ratio	0.034	-	-	0.036	0.154	0.204	0.001	0.007	-	-
HCM Control Delay (s)	8.4	-	-	15.9	10.5	17.4	8.8	7.7	-	-
HCM Lane LOS	A	-	-	C	B	C	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.1	0.5	0.8	0	0	-	-

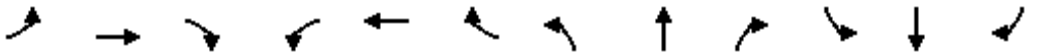
Intersection	
Int Delay, s/veh	3.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	3	4	34	1	0	30
Future Vol, veh/h	3	4	34	1	0	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	80	80	80	80	80	80
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	4	5	43	1	0	38

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	44	0	-	0	57	44
Stage 1	-	-	-	-	44	-
Stage 2	-	-	-	-	13	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1564	-	-	-	950	1026
Stage 1	-	-	-	-	978	-
Stage 2	-	-	-	-	1010	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1564	-	-	-	947	1026
Mov Cap-2 Maneuver	-	-	-	-	947	-
Stage 1	-	-	-	-	975	-
Stage 2	-	-	-	-	1010	-

Approach	EB	WB	SB
HCM Control Delay, s	3.1	0	8.6
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1564	-	-	-	1026
HCM Lane V/C Ratio	0.002	-	-	-	0.037
HCM Control Delay (s)	7.3	-	-	-	8.6
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	98	342	291	21	331	31	198	72	105	100	122	345
Future Volume (vph)	98	342	291	21	331	31	198	72	105	100	122	345
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.97	0.95	0.88	0.97	0.95	1.00	0.97	0.91	0.91	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	2787	3433	3539	1583	3433	3184	1441	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	2787	3433	3539	1583	3433	3184	1441	1770	3539	1583
Peak-hour factor, PHF	0.85	0.90	0.85	0.80	0.90	0.80	0.85	0.85	0.85	0.85	0.85	0.90
Adj. Flow (vph)	115	380	342	26	368	39	233	85	124	118	144	383
RTOR Reduction (vph)	0	0	263	0	0	32	0	33	38	0	0	154
Lane Group Flow (vph)	115	380	79	26	368	7	233	110	28	118	144	229
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	5.6	19.5	19.5	2.0	15.9	15.9	10.5	36.0	36.0	8.7	34.2	34.2
Effective Green, g (s)	5.6	19.5	19.5	2.0	15.9	15.9	10.5	36.0	36.0	8.7	34.2	34.2
Actuated g/C Ratio	0.07	0.23	0.23	0.02	0.19	0.19	0.12	0.43	0.43	0.10	0.41	0.41
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	228	819	645	81	668	298	428	1361	616	182	1437	642
v/s Ratio Prot	c0.03	c0.11		0.01	c0.10		c0.07	0.03		0.07	0.04	
v/s Ratio Perm			0.03			0.00			0.02			c0.14
v/c Ratio	0.50	0.46	0.12	0.32	0.55	0.02	0.54	0.08	0.05	0.65	0.10	0.36
Uniform Delay, d1	38.0	27.9	25.6	40.4	30.9	27.8	34.6	14.3	14.1	36.3	15.5	17.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.8	0.4	0.1	2.3	1.0	0.0	1.4	0.1	0.1	7.7	0.1	1.5
Delay (s)	39.7	28.3	25.7	42.7	31.9	27.9	36.0	14.4	14.2	44.0	15.6	18.9
Level of Service	D	C	C	D	C	C	D	B	B	D	B	B
Approach Delay (s)		28.8			32.2			25.8			22.8	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	27.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	84.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	47.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	0	15	76	0	23	76	353	72	58	206	14
Future Vol, veh/h	4	0	15	76	0	23	76	353	72	58	206	14
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	0	-	-	0	-	0	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	80	80	80	80	80	80	85	90	80	80	85	80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	0	19	95	0	29	89	392	90	73	242	18

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	771	1057	130	837	976	196	260	0	0	482	0	0
Stage 1	397	397	-	570	570	-	-	-	-	-	-	-
Stage 2	374	660	-	267	406	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	290	224	896	259	250	812	1302	-	-	1077	-	-
Stage 1	600	602	-	474	504	-	-	-	-	-	-	-
Stage 2	619	458	-	715	596	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	251	195	896	228	217	812	1302	-	-	1077	-	-
Mov Cap-2 Maneuver	251	195	-	228	217	-	-	-	-	-	-	-
Stage 1	559	561	-	442	470	-	-	-	-	-	-	-
Stage 2	556	427	-	653	555	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	11.3	26.5	1.2	1.9
HCM LOS	B	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1302	-	-	251	896	228	812	1077	-	-
HCM Lane V/C Ratio	0.069	-	-	0.02	0.021	0.417	0.035	0.067	-	-
HCM Control Delay (s)	8	-	-	19.6	9.1	31.6	9.6	8.6	-	-
HCM Lane LOS	A	-	-	C	A	D	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.1	0.1	1.9	0.1	0.2	-	-

Intersection	
Int Delay, s/veh	5.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	36	27	64	0	5	0	81	0	0	1	0	15
Future Vol, veh/h	36	27	64	0	5	0	81	0	0	1	0	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	80	80	80	80	80	80	85	85	85	80	80	80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	45	34	80	0	6	0	95	0	0	1	0	19

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	6	0	0	114	0	0	180	170	74	170	210	6
Stage 1	-	-	-	-	-	-	164	164	-	6	6	-
Stage 2	-	-	-	-	-	-	16	6	-	164	204	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1615	-	-	1475	-	-	782	723	988	794	687	1077
Stage 1	-	-	-	-	-	-	838	762	-	1016	891	-
Stage 2	-	-	-	-	-	-	1004	891	-	838	733	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1615	-	-	1475	-	-	752	703	988	777	668	1077
Mov Cap-2 Maneuver	-	-	-	-	-	-	752	703	-	777	668	-
Stage 1	-	-	-	-	-	-	815	741	-	988	891	-
Stage 2	-	-	-	-	-	-	987	891	-	815	712	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	2.1	0	10.5	8.5
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	752	1615	-	-	1475	-	-	1052
HCM Lane V/C Ratio	0.127	0.028	-	-	-	-	-	0.019
HCM Control Delay (s)	10.5	7.3	-	-	0	-	-	8.5
HCM Lane LOS	B	A	-	-	A	-	-	A
HCM 95th %tile Q(veh)	0.4	0.1	-	-	0	-	-	0.1

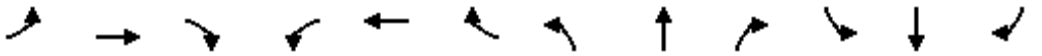
Intersection	
Int Delay, s/veh	0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	19	498	60	0	297
Future Vol, veh/h	0	19	498	60	0	297
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	80	90	80	92	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	24	553	75	0	349

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	277	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	720	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	720	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.2	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	720	-
HCM Lane V/C Ratio	-	-	0.033	-
HCM Control Delay (s)	-	-	10.2	-
HCM Lane LOS	-	-	B	-
HCM 95th %tile Q(veh)	-	-	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	402	386	325	31	400	119	87	37	25	56	57	160
Future Volume (vph)	402	386	325	31	400	119	87	37	25	56	57	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.97	0.95	0.88	0.97	0.95	1.00	0.97	0.91	0.91	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	2787	3433	3539	1583	3433	3315	1441	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	2787	3433	3539	1583	3433	3315	1441	1770	3539	1583
Peak-hour factor, PHF	0.90	0.90	0.90	0.80	0.90	0.85	0.85	0.80	0.80	0.80	0.80	0.85
Adj. Flow (vph)	447	429	361	39	444	140	102	46	31	70	71	188
RTOR Reduction (vph)	0	0	226	0	0	109	0	6	16	0	0	132
Lane Group Flow (vph)	447	429	135	39	444	31	102	48	7	70	71	56
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	15.4	30.3	30.3	3.0	17.9	17.9	5.5	22.9	22.9	6.8	24.2	24.2
Effective Green, g (s)	15.4	30.3	30.3	3.0	17.9	17.9	5.5	22.9	22.9	6.8	24.2	24.2
Actuated g/C Ratio	0.19	0.37	0.37	0.04	0.22	0.22	0.07	0.28	0.28	0.08	0.30	0.30
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	652	1323	1042	127	782	349	233	937	407	148	1057	472
v/s Ratio Prot	c0.13	0.12		0.01	c0.13		0.03	0.01		c0.04	0.02	
v/s Ratio Perm			0.05			0.02			0.00			c0.04
v/c Ratio	0.69	0.32	0.13	0.31	0.57	0.09	0.44	0.05	0.02	0.47	0.07	0.12
Uniform Delay, d1	30.5	18.1	16.7	38.0	28.1	25.1	36.3	21.1	20.9	35.4	20.3	20.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.0	0.1	0.1	1.4	1.0	0.1	1.3	0.1	0.1	2.4	0.1	0.5
Delay (s)	33.5	18.2	16.7	39.4	29.1	25.2	37.6	21.2	21.0	37.8	20.4	21.2
Level of Service	C	B	B	D	C	C	D	C	C	D	C	C
Approach Delay (s)		23.3			28.8			30.5			24.5	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	81.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	43.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑	↱		↱
Traffic Vol, veh/h	0	467	526	40	0	24
Future Vol, veh/h	0	467	526	40	0	24
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	0	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	90	90	80	92	80
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	519	584	50	0	30

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	-	0	-	0	-	292
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	3.32
Pot Cap-1 Maneuver	0	-	-	-	0	704
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	-	-	-	-	-	704
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	10.3
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	-	-	-	704
HCM Lane V/C Ratio	-	-	-	0.043
HCM Control Delay (s)	-	-	-	10.3
HCM Lane LOS	-	-	-	B
HCM 95th %tile Q(veh)	-	-	-	0.1

Intersection	
Int Delay, s/veh	5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	0	95	110	0	16	30	177	14	23	409	5
Future Vol, veh/h	10	0	95	110	0	16	30	177	14	23	409	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	0	-	-	0	-	0	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	80	80	80	85	80	80	80	85	80	80	90	80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	13	0	119	129	0	20	38	208	18	29	454	6

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	695	817	230	569	802	104	460	0	0	226	0	0
Stage 1	515	515	-	284	284	-	-	-	-	-	-	-
Stage 2	180	302	-	285	518	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	329	309	772	405	316	931	1097	-	-	1340	-	-
Stage 1	511	533	-	699	675	-	-	-	-	-	-	-
Stage 2	804	663	-	698	531	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	308	292	772	328	298	931	1097	-	-	1340	-	-
Mov Cap-2 Maneuver	308	292	-	328	298	-	-	-	-	-	-	-
Stage 1	493	521	-	675	651	-	-	-	-	-	-	-
Stage 2	759	640	-	578	519	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	11.1	21	1.2	0.5
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1097	-	-	308	772	328	931	1340	-	-
HCM Lane V/C Ratio	0.034	-	-	0.041	0.154	0.395	0.021	0.021	-	-
HCM Control Delay (s)	8.4	-	-	17.2	10.5	22.9	9	7.7	-	-
HCM Lane LOS	A	-	-	C	B	C	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.1	0.5	1.8	0.1	0.1	-	-

Intersection	
Int Delay, s/veh	5.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	3	4	30	0	34	1	62	0	0	0	0	30
Future Vol, veh/h	3	4	30	0	34	1	62	0	0	0	0	30
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	80	80	80	80	80	80	80	92	92	80	80	80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	5	38	0	43	1	78	0	0	0	0	38

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	44	0	0	43	0	0	95	76	24	76	95	44
Stage 1	-	-	-	-	-	-	32	32	-	44	44	-
Stage 2	-	-	-	-	-	-	63	44	-	32	51	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1564	-	-	1566	-	-	888	814	1052	914	795	1026
Stage 1	-	-	-	-	-	-	984	868	-	970	858	-
Stage 2	-	-	-	-	-	-	948	858	-	984	852	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1564	-	-	1566	-	-	854	812	1052	912	793	1026
Mov Cap-2 Maneuver	-	-	-	-	-	-	854	812	-	912	793	-
Stage 1	-	-	-	-	-	-	981	865	-	967	858	-
Stage 2	-	-	-	-	-	-	913	858	-	981	849	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.6	0	9.6	8.6
HCM LOS			A	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	854	1564	-	-	1566	-	-	1026
HCM Lane V/C Ratio	0.091	0.002	-	-	-	-	-	0.037
HCM Control Delay (s)	9.6	7.3	-	-	0	-	-	8.6
HCM Lane LOS	A	A	-	-	A	-	-	A
HCM 95th %tile Q(veh)	0.3	0	-	-	0	-	-	0.1

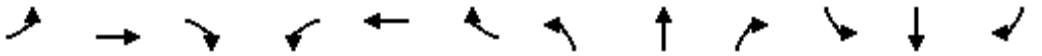
Intersection	
Int Delay, s/veh	0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	14	208	28	0	614
Future Vol, veh/h	0	14	208	28	0	614
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	80	85	80	92	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	18	245	35	0	682

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	123	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	6.94	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.32	-	-	-	-
Pot Cap-1 Maneuver	0	905	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	905	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.1	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	905	-
HCM Lane V/C Ratio	-	-	0.019	-
HCM Control Delay (s)	-	-	9.1	-
HCM Lane LOS	-	-	A	-
HCM 95th %tile Q(veh)	-	-	0.1	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	121	342	291	25	345	36	198	79	105	129	125	360
Future Volume (vph)	121	342	291	25	345	36	198	79	105	129	125	360
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.97	0.95	0.88	0.97	0.95	1.00	0.97	0.91	0.91	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	2787	3433	3539	1583	3433	3199	1441	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	2787	3433	3539	1583	3433	3199	1441	1770	3539	1583
Peak-hour factor, PHF	0.85	0.90	0.85	0.80	0.90	0.80	0.85	0.85	0.85	0.85	0.85	0.90
Adj. Flow (vph)	142	380	342	31	383	45	233	93	124	152	147	400
RTOR Reduction (vph)	0	0	258	0	0	36	0	35	43	0	0	151
Lane Group Flow (vph)	142	380	84	31	383	9	233	114	25	152	147	249
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	7.9	21.1	21.1	3.2	16.4	16.4	10.2	31.6	31.6	12.2	33.6	33.6
Effective Green, g (s)	7.9	21.1	21.1	3.2	16.4	16.4	10.2	31.6	31.6	12.2	33.6	33.6
Actuated g/C Ratio	0.09	0.25	0.25	0.04	0.19	0.19	0.12	0.37	0.37	0.14	0.39	0.39
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	314	867	682	127	674	301	406	1174	528	250	1381	617
v/s Ratio Prot	c0.04	0.11		0.01	c0.11		0.07	0.04		c0.09	0.04	
v/s Ratio Perm			0.03			0.01			0.02			c0.16
v/c Ratio	0.45	0.44	0.12	0.24	0.57	0.03	0.57	0.10	0.05	0.61	0.11	0.40
Uniform Delay, d1	37.0	27.5	25.3	40.3	31.6	28.4	35.9	17.9	17.6	34.7	16.7	19.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	0.4	0.1	1.0	1.1	0.0	2.0	0.2	0.2	4.1	0.2	2.0
Delay (s)	38.1	27.8	25.4	41.3	32.7	28.4	37.9	18.0	17.7	38.9	16.9	21.0
Level of Service	D	C	C	D	C	C	D	B	B	D	B	C
Approach Delay (s)		28.6			32.9			28.3			24.0	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	28.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	86.1	Sum of lost time (s)	18.0
Intersection Capacity Utilization	48.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑	↱		↱
Traffic Vol, veh/h	0	576	388	18	0	18
Future Vol, veh/h	0	576	388	18	0	18
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	0	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	90	90	80	92	80
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	640	431	23	0	23

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	-	0	-	0	-	216
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	3.32
Pot Cap-1 Maneuver	0	-	-	-	0	789
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	-	-	-	-	-	789
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	9.7
HCM LOS			A

Minor Lane/Major Mvmt	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	-	-	-	789
HCM Lane V/C Ratio	-	-	-	0.029
HCM Control Delay (s)	-	-	-	9.7
HCM Lane LOS	-	-	-	A
HCM 95th %tile Q(veh)	-	-	-	0.1

INNOVATION STARBUCKS
INNOVATION PARK DRIVE/TANGERINE ROAD
REVISED TRAFFIC IMPACT ANALYSIS

APPENDIX

Turn Lane Calculations

Un-Signalized Intersection (Right Turn Lane)
Location: South Access
Approach/Leg: Westbound **2024 With**

V = vehicles per hour Vehicle Length = 25 feet

AM Peak Hour
V = 40 vph Vehicles per 2 min. period = 1.333 vehicles

S = Storage = vehicles per 2 min. period x 25 feet

S (ft) = 1.333 vehicles X 25 feet = 33 feet

Minimum Recommended Storage: 50 feet

Un-Signalized Intersection (Right Turn Lane)
Location: West Access
Approach/Leg: Northbound **2024 With**

V = vehicles per hour Vehicle Length = 25 feet

AM Peak Hour
V = 60 vph Vehicles per 2 min. period = 2 vehicles

S = Storage = vehicles per 2 min. period x 25 feet

S (ft) = 2 vehicles X 25 feet = 50 feet

Minimum Recommended Storage: 50 feet

Signalized Intersection (Right Turn Lane)
Location: Innovation Park Road/Tangerine Road
Approach/Leg: Westbound **2024 With**

V = vehicles per hour Vehicle Length = 25 feet

AM Peak Hour
V = P vph Vehicles per 2 min. period = ##### vehicles

S = Storage = vehicles per 2 min. period x 25 feet

S (ft) = ##### vehicles X 25 feet = ##### feet

Minimum Recommended Storage: ##### feet

INNOVATION STARBUCKS
INNOVATION PARK DRIVE/TANGERINE ROAD
REVISED TRAFFIC IMPACT ANALYSIS

APPENDIX

Spack Report

COUNTINGcars.com

Drive-Through Queue Generation

Mike Spack, PE, PTOE, Max Moreland, EIT, Lindsay de Leeuw, Nate Hood

1.0 Introduction

This report provides queuing data for businesses with drive-through services. It is intended to be an aid for site designers and reviewers, similar to the Institute of Transportation Engineers' *Trip Generation* and *Parking Generation* reports. The data presentation is modeled on the *Parking Generation* report and data is provided based on at least six sites, similar to data sets marked as statistically significant in *Trip Generation*.

Businesses with drive-through lanes are very common in the United States and having data that gives usage information for drive-through lanes will assist designers as well as cities in determining the appropriate amount of storage needed for proposed drive-through businesses. Data for drive-through queues was published by the ITE Technical Council Committee 5D-10 in 1995 based on information collected between the late 1960's and the 1990's. A paper was also published in 2009 by Mark Stuecheli, PTP giving updated information for bank and coffee shop drive-through lanes. The results from the 2009 study are incorporated into this paper (thank you Mark for your assistance).

2.0 Data Collection

Data was collected using COUNTcam video recording systems at a total of 30 drive-through locations in Minneapolis, MN and several surrounding suburbs between 2010 and 2012 (26 of the 30 videos were recorded in February of 2012, which should represent peak usage in the cold Minnesota winter). Videos of drive-through lanes were collected at banks, car washes, coffee shops, fast food restaurants and pharmacies. A total of six locations were selected for each of the five different land uses. Each location was recorded for between one and five days where the majority of locations were recorded for two consecutive days. The days of the week that each video was recorded on varies.

The 24-hour videos were watched at high speeds with the PC-TAS counting software and maximum queues throughout the day were noted. Most of the COUNTcams were set up such that the entire queue lane could be seen, but at a few locations the drive-through lanes wrapped around the building in a way that the entire queue length would not be able to be seen. For these situations, the COUNTcams were set up so that the ordering window and back of the queue could be seen and it was noted how many vehicles could fit between the ordering window and the front of the queue. For drive-through locations with multiple lanes, the number of lanes was noted but the maximum queue is defined as the sum of the queues at each lane for any given point in time, not the queue per lane. This approach provides overall demand, which may assist designers in determining how many drive through lanes are appropriate in addition to determining how long they should be.

Once the maximum queue for each day at each location was determined, the data was compiled and statistics for each land use were calculated. The average maximum queue, standard deviation, coefficient of variation, range, 85th percentile and 33rd percentile were calculated for each land use.

Data for drive-through coffee shops and banks from the Kansas City, Kansas metropolitan area was published in the 2009 paper New Drive-Through Stacking Information for Banks and Coffee Shops by Mark Stuecheli. This data is included in the analysis.

3.0 Data Analysis

Based on the peak queue lengths, it is apparent that each land use will require a different minimum drive through stacking distance. The results for each land use can be found below. The peak queue lengths for each location, broken down by land use and day of the week, can be found in the Appendix.

3.1 Banks

Data collection was done at six banks with drive-through services (including one credit union) in August 2011 and February 2012. Twelve days of data were collected. The banks were located in the cities of Minneapolis, Robbinsdale and St. Louis Park, MN.

All of the locations had a lane with a drive-through ATM and at least two other lanes. Though service times may differ for ATM lanes compared to the regular lanes, the maximum queues were counted together. This is because based upon what was observed, vehicles would occasionally switch the lane they were in. For example, a vehicle waiting in the ATM line with a queue of three vehicles may move over to a regular line with a queue of only one vehicle. Much of what can be done at the bank's drive-through lane can also be accomplished at that bank's ATM and vice versa. Vehicles being served were counted as being in the queue.

Nine days of data from the Kansas City, Kansas area is also included. This data does not factor in vehicles in ATM lanes.

Table 3.1 – Drive-Through Bank Maximum Queue Statistics

	Minnesota Data	Minnesota + Kansas Data
Number of Data Points	**12**	**21**
Average Maximum Queue (Vehicles)	**5.83**	**5.76**
Standard Deviation (Vehicles)	**1.85**	**2.21**
Coefficient of Variation	**32%**	**38%**
Range (Vehicles)	**3 to 8**	**1 to 10**
85th Percentile (Vehicles)	**8.00**	**8.00**
33rd Percentile (Vehicles)	**5.00**	**5.00**

Figure 3.1.1 – Drive-Through Bank Maximum Queue Frequency – Minnesota Data

Figure 3.1.2 – Drive-Through Bank Maximum Queue Frequency – Minnesota + Kansas Data

The data for Kansas banks was collected between 4:30pm and 6:00pm. While many of the maximum queues for the data collected in Minnesota were between these times, maximum queues occurred between 8:30am and 5:30pm so it is possible that some of the Kansas data does not capture the actual maximum queues for the day.

The number of available lanes at banks, not including the ATM lane, ranged from two to seven lanes (though the most open at one time was five lanes). Even though plenty of lanes were available, cars often stacked at the lane closest to the building, thus additional lanes may not result in shorter queues. With an 85th percentile maximum queue of eight vehicles, the data suggests that banks with drive-through lanes should be able to accommodate 160 feet of vehicle stacking.

3.2 Car Washes

Data collection was done at six car washes with drive-through services (including one full-service car wash) in February 2012. Twelve days of data were collected. The car washes were located in the cities of Falcon Heights, Hopkins, Minneapolis, Roseville and St. Louis Park, MN. Five of the six car washes (excluding the full-service car wash) were located at gas stations. Only the vehicles waiting in line were counted; vehicles being washed were not added to the queue.

Table 3.2 – Drive-Through Car Wash Maximum Queue Statistics

Number of Data Points	**12**
Average Maximum Queue (Vehicles)	**4.42**
Standard Deviation (Vehicles)	**2.31**
Coefficient of Variation	**52%**
Range (Vehicles)	**1 to 10**
85th Percentile (Vehicles)	**6.20**
33rd Percentile (Vehicles)	**3.00**

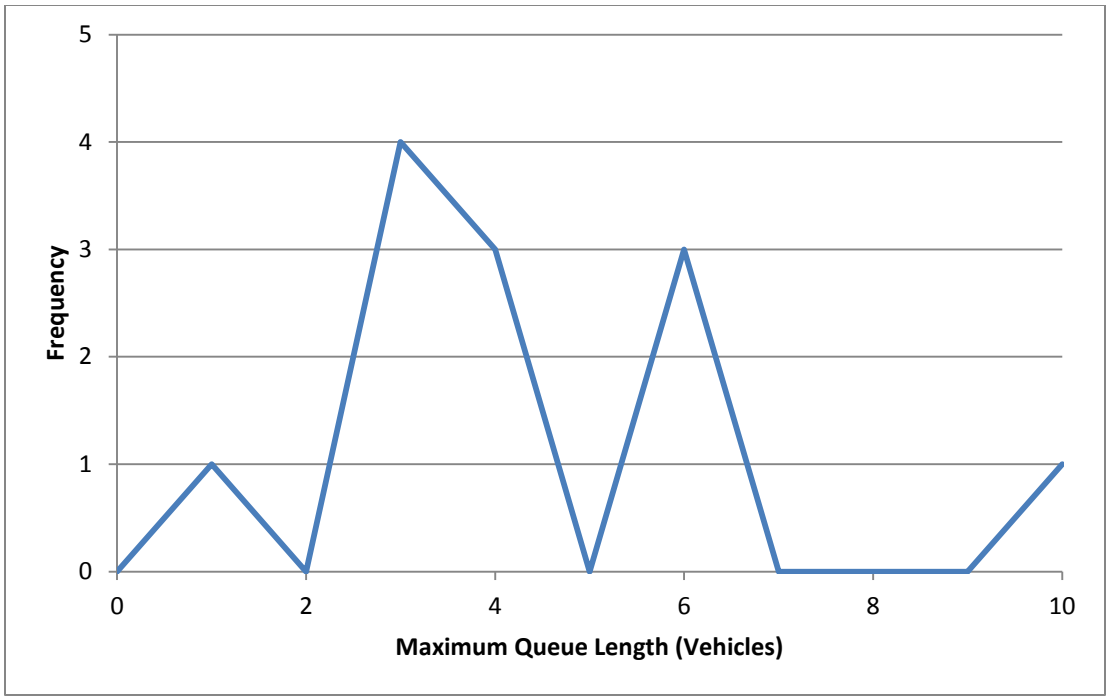


Figure 3.2 – Drive-Through Car Wash Maximum Queue Frequency

Two of the car washes had two lanes while the other four were one lane car washes. The full-service car wash had two lanes and also produced the highest maximum queue of 10 vehicles. The maximum queues for car washes were spread throughout the afternoon from 12:30pm to 8:30pm. With an 85th percentile maximum queue of more than six vehicles, the data suggests that car washes with drive-through lanes should be able to accommodate 140 feet of vehicle stacking throughout the day.

3.3 Coffee Shops

Data collection was done at six coffee shops with drive-through services in November 2010, August 2011 and February 2012. Fourteen days of data were collected. The coffee shops were located in the cities of Edina, Hopkins, Minneapolis, Roseville and St. Louis Park, MN. Vehicles being served were counted as being in the queue. Twelve days of data from the Kansas City, Kansas area is also included.

Table 3.3 – Drive-Through Coffee Shop Maximum Queue Statistics

	Minnesota Data	Minnesota + Kansas Data
Number of Data Points	14	26
Average Maximum Queue (Vehicles)	11.00	10.23
Standard Deviation (Vehicles)	2.25	2.76
Coefficient of Variation	20%	27%
Range (Vehicles)	7 to 16	3 to 16
85th Percentile (Vehicles)	13.50	13.00
33rd Percentile (Vehicles)	10.00	9.91

Figure 3.3.1 – Drive-Through Coffee Shop Maximum Queue Frequency – Minnesota Data

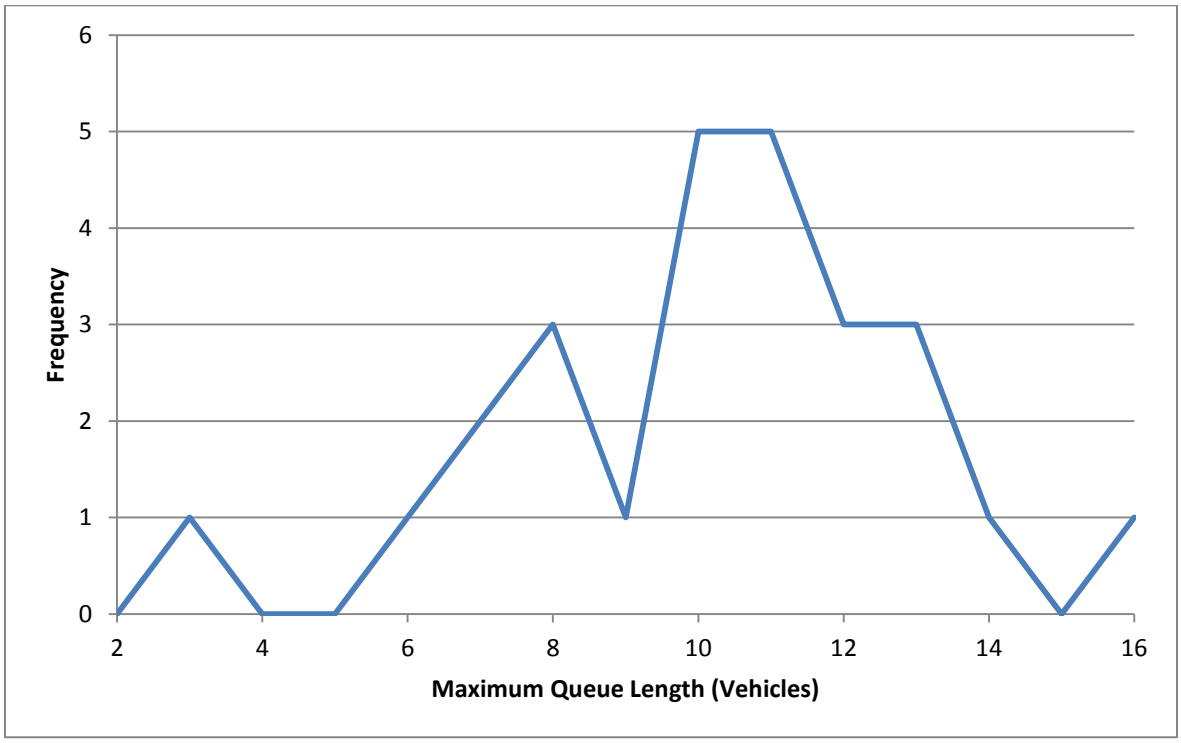


Figure 3.3.2 – Drive-Through Coffee Shop Maximum Queue Frequency – MN + KS Data

Coffee shops produced the longest maximum queues of any of the land uses in this study with all of the maximum queues occurring in the morning. In four of the six cases, the queues spilled out of the parking lot and into the street. These spillovers would typically only happen once or twice a day and last only a few minutes, however, one location had stacking into the street for about 15 minutes in addition to multiple periods of several minutes where cars would queue in the street.

With an 85th percentile maximum queue of 13 vehicles, the data suggests that coffee shops with drive-through lanes should be able to accommodate at least 260 feet of vehicle stacking during morning hours.

3.4 Fast Food Restaurants

Data collection was done at six fast food restaurants with drive-through services in August 2011 and February 2012. Fourteen days of data were collected. The restaurants were located in the cities of Golden Valley, Hopkins, Minneapolis and St. Louis Park, MN. Vehicles being served were counted as being in the queue.

Table 3.4 – Drive-Through Fast Food Restaurant Maximum Queue Statistics

Number of Data Points	**14**
Average Maximum Queue (Vehicles)	**8.50**
Standard Deviation (Vehicles)	**2.68**
Coefficient of Variation	**32%**
Range (Vehicles)	**5-13**
85th Percentile (Vehicles)	**12.00**
33rd Percentile (Vehicles)	**7.90**

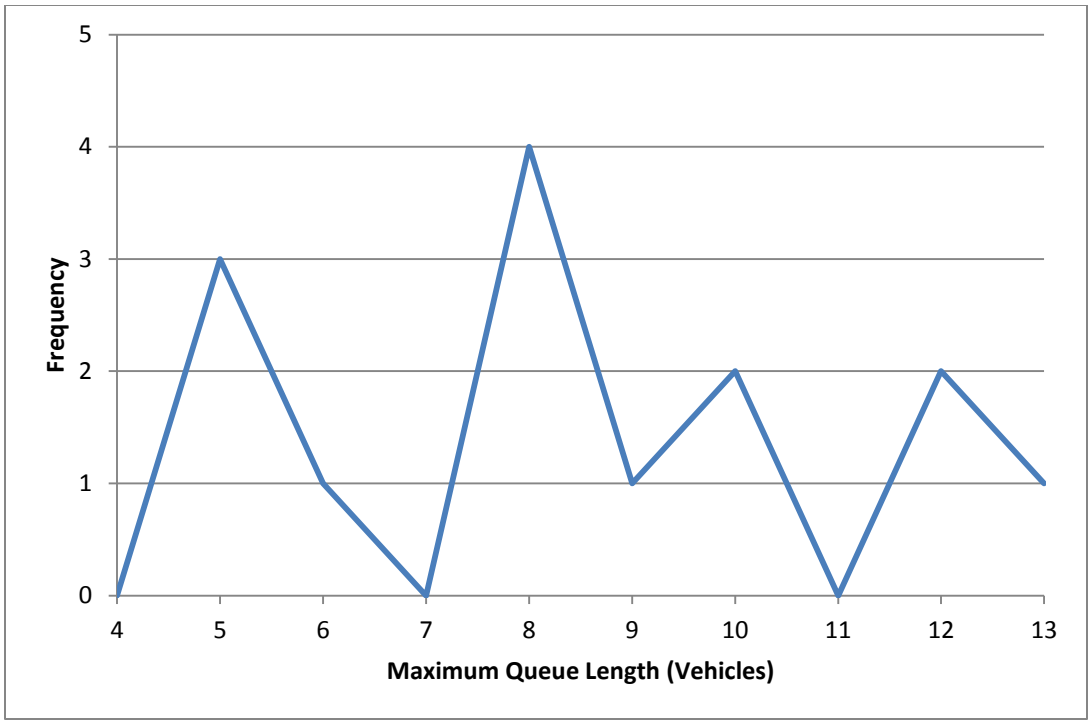


Figure 3.4 – Drive-Through Fast Food Restaurant Maximum Queue Frequency

The maximum queues for fast food restaurants were spread throughout the day from 8:00am to 10:00pm. With an 85th percentile maximum queue of 12 vehicles, the data suggests that fast food restaurants with drive-through lanes should be able to accommodate 240 feet of vehicle stacking throughout the day.

3.5 Pharmacies

Data collection was done at six pharmacies with drive-through services in February 2012. Twelve days of data were collected. The pharmacies were located in the cities of Hopkins, Minneapolis, New Hope and Robbinsdale, MN. Vehicles being served were counted as being in the queue.

Table 3.5 – Drive-Through Pharmacy Maximum Queue Statistics

Number of Data Points	**12**
Average Maximum Queue (Vehicles)	**2.92**
Standard Deviation (Vehicles)	**1.16**
Coefficient of Variation	**40%**
Range (Vehicles)	**1-5**
85th Percentile (Vehicles)	**4.05**
33rd Percentile (Vehicles)	**2.00**

Figure 3.5 – Drive-Through Pharmacy Maximum Queue Frequency

The maximum queues for pharmacies were spread throughout the day from 8:00am to 10:00pm. With an 85th percentile maximum queue of more than 4 vehicles, the data suggests that pharmacies with drive-through lanes should be able to accommodate 100 feet of vehicle stacking throughout the day.

4.0 Conclusions

The 85th percentile maximum queue lengths for each land use are: 160 feet for banks (eight vehicles), 140 feet for car washes (seven vehicles), 260 feet for coffee shops (13 vehicles), 240 feet for fast food restaurants (12 vehicles) and 100 feet for pharmacies (five vehicles).

While some of the locations observed have an excess of space dedicated to drive-through lanes (i.e. some banks and pharmacies), others could occasionally use additional space for drive-through lanes (i.e. coffee shops in the morning).

Fast food restaurants and coffee shops have the longest maximum queues of the five land uses observed. Coffee shops have a tendency for the morning queues to build so long that they spill out onto the street, though, as is expected, their afternoon and evening queues are minimal. Fast food restaurants also have large queues, but they tended to have enough dedicated space that stacking did not go beyond the designated queuing area.

The data collected for this paper along with the data from the papers by Mark Stuecheli and the ITE Technical Committee 5D-10 (see Appendix for both of these) will hopefully provide useful data for traffic engineers and others trying to analyze drive-through queuing storage areas.

5.0 Labor Savings of the COUNTkit

Deploying people in the field to perform this data collection would not have been feasible. Using the COUNTcam video system made it possible to observe the drive through lanes 24 hours a day and the PC-TAS software made the data reduction practical. One location was recorded in November 2010 for 6 hours, three locations were recorded in August 2011 for a total of 202 hours and 26 locations were recorded in February 2012 for a total of 1012 hours. These 1220 hours of video were counted with a total of 120 hours of labor, meaning the videos were watched at approximately 10x speed. Installation of a COUNTcam takes approximately 10 minutes and retrieval takes approximately 5 minutes. This whole project was completed in approximately 3 weeks.

6.0 References

1. Stuecheli, M. (2009). New Drive-Through Stacking Information for Banks and Coffee Shops. *ITE 2009 Annual Meeting and Exhibit.* Print.
2. ITE Technical Committee 5D-10. "Queuing Areas for Drive-Thru Facilities." *ITE Journal* (May 1995): 38-42. Print.
3. Institute of Transportation Engineers. *Parking Generation.* 4th ed. Washington, DC: Institute of Transportation Engineers, 2010. Print.
4. Institute of Transportation Engineers. *Trip Generation.* 8th ed. Washington, DC: Institute of Transportation Engineers, 2008. Print.

7.0 Appendix

A – Day of Week Maximum Queues
B – New Drive-Through Stacking Information for Banks and Coffee Shops
C – ITE Technical Committee 5D-10: Queuing Areas for Drive-Thru Facilities
D – Drive-Through Data Forms

Appendix A

Day of Week Maximum Queues

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Fast Food	Arby's				5	5		
	Burger King	6	12				10	8
	McDonald's				12	13		
	McDonald's				9	8		
	Taco Bell				10	8		
	White Castle				8	5		
Car Wash	BP				6	6		
	BP			1	3			
	BP			4	3			
	Holiday				3	4		
	Mister Car Wash				10	6		
	Mobil				4	3		
Coffee	Caribou				11	10		
	Caribou	7	10	12			12	8
	Starbucks				14	16		
	Starbucks				10	11		
	Starbucks			10	12			
	Starbucks				11			
Bank	Citizens Independent Bank			5	5			
	SharePoint Credit Union				3	3		
	TCF	4					8	8
	US Bank				7	7		
	Wells Fargo			8	6			
	Wells Fargo			6				
Pharmacy	CVS			1	2			
	CVS			4	4			
	CVS			2	2			
	Walgreens				4	5		
	Walgreens			3	3			
	Walgreens			3	2			

INNOVATION STARBUCKS
INNOVATION PARK DRIVE/TANGERINE ROAD
REVISED TRAFFIC IMPACT ANALYSIS

APPENDIX

Comment Resolution

Item No.	Page No.	Reviewer	Code	Comments	Response
				Town of Oro Valley	
1	General	Cheryl Huelle	D	Revisit the pedestrian access from the South Access off Tangerine as sidewalk is required along Tangerine and should connect to sidewalk within the development.	See revised site plan and report.
2	16	Cheryl Huelle	A	Total trips entering/exiting the site are not equivalent to the trip generation calculations.	See revised report.
3	General	Cheryl Huelle	A	All left-turn movements at Innovation Park Dr & Tangerine Rd are protected only. Please revise analysis to reflect the protected lefts.	See revised report.
4	17	Cheryl Huelle	D	What is adequate? LOS C? D? And what source verifies this?	See level of service criteria on page 17 of the revised report.
5	5	Cheryl Huelle	A	Site plan on page 5 of TS does not match submitted site plan; update and revise as needed.	See revised site plan and report.
6	General	Cheryl Huelle	A	Volumes in the southbound left turn lane (Vistoso Park Road South/Innovation Park Drive) are inconsistent (TYP all figures.)	See revised report.
7	12	Cheryl Huelle	A	First paragraph for the south access, the existing right-turn lane should be extended to provide a continuous right-turn lane with the additional calculated 50 ft of storage needed for the south access driveway.	See revised Report.
8	General	Cheryl Huelle	A	West access, please verify that the 285 ft distance from Tangerine is acceptable (not the typical 330 ft).	See revised report.

A - Will Revise
B - Consultant to Evaluate
C - Town of Oro Valley to Evaluate
D - See Response

SOUTHWEST TRAFFIC ENGINEERING, LLC

Innovation Starbucks TIA
Dated 5 October 2023
Comment Resolution

12/11/2023

Item No.	Page No.	Reviewer	Code	Comments	Response
				Town of Oro Valley	
1	General	Cheryl Huelle	D	Change in SF noted and accounted for in TIA.	Noted.
2	12	Cheryl Huelle	D	Noted that no pass-by trips were applied.	Noted.
3	Figure 5 13	Cheryl Huelle	A	Shouldn't the thru be proposed to match the recommendations? (Referring to the eastbound approach at Vistoso Park Rd South/Innovation Park Drive)	The eastbound through movement at intersection 4 in this figure is not be shown as it is not an existing condition. See Figure 11 for proposed stripign change.
4	23	Cheryl Huelle	A	The Figure from the COT Guidelines need to be included in the appendix, OR the report text needs to state the Figure # and traffic volumes used.	See revised report.
5	23	Cheryl Huelle	A	Tangerine? (Referring to the typo in the turn lane section stating "South Access/Innovation Park Drive"	This is a typo. See revised report.
6	23	Cheryl Huelle	A	Warrants?? (Referring to Comment 4 and the paragraph talking about queue lengths)	See response to Comment 4.
7	23	Cheryl Huelle	A	Add a note that Queue Length does not include braking distance, gap or taper.	See revised report. However, being in a urban environment, the braking manuever is expected to occur prior to the turn lane taper rather than within the turn lane.
8	24	Cheryl Huelle	A	Tangerine? (Referring to the typo in the first paragraph on page 24)	This is a typo. See revised report.
9	24	Cheryl Huelle	A	Table 8 - Innovation Pk Rd/Tangerine Rd with a calculated queue length of 100 ft. Page 26 says 100 ft or less.	Queue of 100 feet is correct. See revised report.
10	24	Cheryl Huelle	D	This is stated in the PC/COT Signing & Pavement Marking Manual, and referenced here in this report. It is a standard practice. (Referring to the entire second paragraph on page 24 and the phrase "Town of Oro Valley Direction" in the third paragraph on page 24.	The phrase "per Town of Oro Valley" was used when addressing comments/direction made by the Town.
11	24	Cheryl Huelle	D	Clarify if this is storage or includes breaking distance, and/or gap.	Storage does not include breaking distance, and gap. See response to Comment 7 and revised report.
12	24	Cheryl Huelle	D	This is somewhat short given the research conducted by the Town for Starbucks. Need a statement on how the overflow will be routed. (Referring to the 300 feet of storage provided by the coffee shop drive thru line)	See revised report.
13	24	Cheryl Huelle	D	Town has conducted and used our own research - believe we've used 17 in the Queue. (Referring to the last paragraph on page 24 referencing the Spack Report)	Noted.
14	25	Cheryl Huelle	D	Add information about this site - the site plan shows 14, the 17th car would be in conflict with the crosswalk, but not the driveway	See revised report.
15	25	Cheryl Huelle	D	Tangerine Rd, within Oro Valley, has existing multi-use path along the south side and portions of the north side. To match existing, the Town prefers to install a 10 ft wide MUP, that is separated from the edge of the road a minimum of 4 ft.	See offsite improvement plans.
16	26	Cheryl Huelle	D	Add more about the NB right-turn at West Access, see comment on next page. Coordinate with TIA.	See revised report.
17	26	Cheryl Huelle	D	Discuss how this geometrically works (i.e northbound right at West Access), even though it's not the standard dimension	See revised report.
18	26	Cheryl Huelle	A	Tangerine. (Referring to the typo in the turn lane section stating "South Access/Innovation Park Drive"	See revised report.
19	26	Cheryl Huelle	D	This is stated in the PC/COT Signing & Pavement Marking Manual, and referenced as so in this report. It is standard prac	See response to Comment 10.
20	27	Cheryl Huelle	D	More information is needed here - It appears that the West Access will be within the left-turn lane taper for the Vistoso Park Rd South intersection. Will the NB left-turn lane for the West Access extend through the West Access, to the existing NB left-turn lane for Vistoso Park Rd South? This would require the full-width of the existing left-turn lane to be extended. Or would the taper for the existing left-turn lane be shortened? Perhaps this information could be added at the beginning of the Conclusion where the West Access is discussed.	See revised report.
21	27	Cheryl Huelle	D	MUP (Referring to the change requested in Comment 15)	See response to Comment 15.

A - Will Revise
B - Consultant to Evaluate
C - Town of Oro Valley to Evaluate
D - See Response

Innovation Starbucks TIA
Dated 7 March 2024
Comment Resolution

Item No.	Page No.	Reviewer	Code	Comments	Response
				Town of Oro Valley	
1	3	Cheryl Huelle	D	See note pg 24 [Referring to the text in the turn lane analysis stating turn lanes are expected to generate queues of "100 feet or less"]	See response to Comment 3.
2	4	Cheryl Huelle	D	See note pg 24 [Referring to the text in the recommendations stating the existing westbound right turn lane at the intersection of Innovation Park Drive/Tangerine Road should be extended for an additional "150 feet"]	See response to Comment 3.
3	24	Cheryl Huelle	D	The Town accepts ADOT turn lane requirements. The offsite improvement plans show a 60' taper with 150' storage. See ADOT note below - min 40' taper + 50' storage + 85' braking = 175' total. Review ADOT and add necessary information to TIA, correct min requirements (typ). [Referring to the text stating all turn lanes should be constructed to provide 150 feet of storage per the "minimum requirements" in the Pima County and Tucson requirements.]	Per discussions with Oro Valley, City of Tucson/AASHTO/Pima County guidelines as outlined in the TIA will be used in the analysis for turn lane length.
4	27	Cheryl Huelle	D	See note pg 24 [Referring to the text in the conclusion about turn lanes meeting "Town of Oro Valley Guidelines."	See response to Comment 3.

A - Will Revise
B - Consultant to Evaluate
C - Town of Oro Valley to Evaluate
D - See Response