APPENDIX E-2

Greenzone Industrial Development

Traffic Impact Study
April 2021

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VRPA TECHNOLOGIES, INC.

Greenzone Industrial Development
Traffic Impact Study

Study Team

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Executive Summary

This Traffic Impact Study (TIS) has been prepared for the purpose of analyzing traffic conditions related to the proposed development of an industrial-commercial project with approximately 22 lots. The Project site is located in the northern portion of the City of Livingston along Bird Street. Figures 1-1 and 1-2 graphically display the location of the Project and the surrounding roadway network. Figure 1-3 provides the site map for the Project.

PROJECT ACCESS

The access/egress from the site will be located along Bird Street, approximately one-half mile west of the Bird Street and Livingston Cressey Road intersection. The site map includes two (2) driveways or access/egress points from Bird Street.

STUDY AREA

The following intersections and roadway segments included in this TIS were determined in consultation with City of Livingston staff and include:

Intersections

- ✓ Bird Street at Livingston Cressey Road
- ✓ Campbell Boulevard at Main Street
- ✓ Winton Parkway at SR 99 NB Ramps
- ✓ Winton Parkway at SR 99 SB Ramps
- ✓ Hammatt Avenue at SR 99 NB Ramps
- ✓ Hammatt Avenue at SR 99 SB Ramps

Roadway Segments

- ✓ Bird Street between:
  - Livingston Cressey Road and Project Driveway
- ✓ Main Street between:
  - Bird Street and Campbell Boulevard

IMPACTS

Intersections

Table E-1 shows intersections that are expected to fall short of desirable operating conditions for various scenarios. Potential mitigation measures are discussed in Chapter 4 of this report. Results of the analysis show that the Project will cause or contribute to an unacceptable LOS at all of the study intersections with the exception of Livingston Cressey Road at Bird Street when comparing the Cumulative Year 2042 Without Project and Cumulative Year 2042 Plus Project

scenarios.

Segments

Results of the segment analysis along the existing street and highway system are reflected in Table E-2. Results of the analysis show that all of the roadway segments will operate at acceptable levels of service through the Cumulative Year 2042 Plus Project scenario.

Table E-1
Intersection Operations

INTERSECTION	CONTROL	TARGET LOS	PEAK HOUR	EXISTING		EXISTING PLUS PROJECT		NEAR-TERM PLUS PROJECT		CUMULATIVE YEAR 2042 WITHOUT PROJECT		CUMULATIVE YEAR 2042 PLUS PROJECT	
				DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS
1. Livingston Cressey Road / Bird Street	One-Way Stop	C	AM	9.7	A	10.3	B	10.4	B	10.2	B	14.8	B
			PM	10.0	B	10.9	B	11.0	B	10.6	B	11.6	B
2. Main Street / Campbell Boulevard	All-Way Stop	C	AM	**38.3**	**E+**	**41.0**	**E+**	**68.1**	**F++**	**149.4**	**F++**	**159.3**	**F++**
			PM	13.8	B	14.2	B	17.6	C	**35.5**	**E++**	**36.8**	**E++**
3. Winton Parkway / SR 99 NB Ramps	All-Way Stop	C	AM	16.1	C	19.2	C	21.4	C	**57.5**	**F++**	**58.4**	**F++**
			PM	22.3	C	22.4	C	**26.1**	**D+**	**74.9**	**F++**	**75.3**	**F++**
4. Winton Parkway / SR 99 SB Ramps	All-Way Stop	C	AM	**169.8**	**F++**	**170.6**	**F++**	**197.2**	**F++**	**371.5**	**F++**	**--***	**F++**
			PM	**191.2**	**F++**	**191.9**	**F++**	**219.5**	**F++**	**--***	**F++**	**--***	**F++**
5. Hammatt Avenue / SR 99 NB Ramps	All-Way Stop	C	AM	**37.0**	**E++**	**37.7**	**E++**	**136.0**	**F++**	**226.3**	**F++**	**227.6**	**F++**
			PM	**26.5**	**D++**	**27.2**	**D++**	**104.8**	**F++**	**193.6**	**F++**	**196.1**	**F++**
6. Hammatt Avenue / SR 99 SB Ramps	All-Way Stop	C	AM	23.6	C	23.6	C	**68.1**	**F++**	**140.5**	**F++**	**140.5**	**F++**
			PM	20.0	C	20.0	C	**43.8**	**E++**	**91.0**	**F++**	**91.2**	**F++**

DELAY is measured in seconds
LOS = Level of Service / **BOLD** denotes LOS standard has been exceeded
For All-Way Stop intersections, delay results show the average for the entire intersection. For one-way stop controlled intersections, delay results show the delay for the worst movement.
+ Does not meet peak hour signal warrants.
++ Meets peak hour signal warrants.
* Delay Exceeds 300 seconds.

Table E-2
Segment Operations

STREET SEGMENT	SEGMENT DESCRIPTION	DIRECTION	TARGET LOS	PEAK HOUR	EXISTING		EXISTING PLUS PROJECT		NEAR-TERM PLUS PROJECT		CUMULATIVE YEAR 2042 WITHOUT PROJECT		CUMULATIVE YEAR 2042 PLUS PROJECT	
					VOLUME	LOS	VOLUME	LOS	VOLUME	LOS	VOLUME	LOS	VOLUME	LOS
Bird Street														
Livingston Cressey Road to Project Driveway	2 Lanes Undivided	EB	C	AM	2	C	9	C	9	C	3	C	10	C
				PM	8	C	35	C	35	C	11	C	38	C
		WB		AM	6	C	29	C	29	C	8	C	31	C
				PM	8	C	19	C	19	C	11	C	22	C
Main Street														
Bird Street to Olive Avenue	2 Lanes Undivided	NB	C	AM	68	C	90	C	92	C	91	C	113	C
				PM	67	C	77	C	80	C	89	C	100	C
		SB		AM	79	C	86	C	89	C	105	C	112	C
				PM	98	C	124	C	127	C	131	C	156	C
Olive Avenue to Campbell Boulevard	4 Lanes Undivided	NB	C	AM	407	C	424	C	474	C	577	C	594	C
				PM	307	C	315	C	366	C	448	C	457	C
		SB		AM	450	C	455	C	505	C	633	C	638	C
				PM	338	C	358	C	411	C	491	C	511	C

LOS = Level of Service / **BOLD** denotes LOS standard has been exceeded

MITIGATION

This section describes potential improvements to mitigate the traffic impacts of the Project. Described below are potential improvements at study area intersections for various scenarios. In order to mitigate the Project's impacts, the Project may be required to build improvements that are identified under the 'Existing Plus Project' condition to improve identified LOS deficiencies. The Project will be required to contribute a fair share towards the costs of improvements that are identified for the Cumulative Year 2042 scenarios.

Recommended Improvements

Intersections

✓ Main Street at Campbell Boulevard
Recommended improvements to achieve acceptable levels of service:
- Near-Term Plus Project scenario:
  - Install Traffic Signal

- Cumulative Year 2042 Plus Project scenario:
  - Install Traffic Signal
  - Widen the westbound approach to 1 left turn lane, 1 through lane, and 1 right turn lane (adding 1 right turn lane)

The improvements identified above for the Near-Term Plus Project, and Cumulative Year 2042 Plus Project scenarios are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'. Improvements were not recommended for the Existing Plus Project scenario since the minor street approach does not generate enough traffic to justify installation of a traffic signal.

✓ Winton Parkway at SR 99 NB Ramps
Recommended improvements to achieve acceptable levels of service:
- Cumulative Year 2042 Plus Project scenario:
  - Install Traffic Signal
  - Widen the southbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)

The improvements identified above for the Cumulative Year 2042 Plus Project scenario are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'.

✓ Winton Parkway at SR 99 SB Ramps
Recommended improvements to achieve acceptable levels of service:
- Existing Plus Project and Near-Term Plus Project scenarios:
  - Install Traffic Signal

- Widen the northbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)
- Widen the eastbound approach to 1 left turn lane and 1 right turn lane (adding 1 left turn lane)

- Cumulative Year 2042 Plus Project scenario:
  - Install Traffic Signal
  - Widen the northbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)
  - Widen the eastbound approach to 1 left turn lane and 2 right turn lane (adding 1 left turn lane and 1 right turn lane)

The improvements identified above for the Existing Plus Project, Near-Term Plus Project, and Cumulative Year 2042 Plus Project scenarios are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'.

✓ <u>Hammatt Avenue at SR 99 NB Ramps</u>
Recommended improvements to achieve acceptable levels of service:

- Existing Plus Project scenario:
  - Install Traffic Signal

- Near-Term Plus Project scenario:
  - Install Traffic Signal
  - Widen the westbound approach to 1 left-through lane and 2 right turn lanes (adding 1 right turn lane)

- Cumulative Year 2042 Plus Project scenario:
  - Install Traffic Signal
  - Widen the southbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)
  - Widen the westbound approach to 1 left-through lane and 2 right turn lanes (adding 1 right turn lane)

The improvements identified above for the Existing Plus Project, Near-Term Plus Project, and Cumulative Year 2042 Plus Project scenarios are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'.

✓ <u>Hammatt Avenue at SR 99 SB Ramps</u>
Recommended improvements to achieve acceptable levels of service:

- Near-Term Plus Project scenario:
  - Install Traffic Signal

- Cumulative Year 2042 Plus Project scenario:

- Install Traffic Signal
- Widen the northbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)

The improvements identified above for the Near-Term Plus Project and Cumulative Year 2042 Plus Project scenarios are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'.

Post-Mitigation Level of Service

The level of service resulting from the potential improvements identified above is shown in Table E-3 for study area intersections.

Table E-3
Intersection Operations with Mitigation

INTERSECTION	CONTROL	TARGET LOS	PEAK HOUR	EXISTING PLUS PROJECT		NEAR-TERM PLUS PROJECT		CUMULATIVE YEAR 2042 PLUS PROJECT	
				DELAY	LOS	DELAY	LOS	DELAY	LOS
2. Main Street / Campbell Boulevard	Signalized	C	AM			22.1	C	23.4	C
			PM			17.7	B	19.3	B
3. Winton Parkway / SR 99 NB Ramps	Signalized	C	AM					14.4	B
			PM					32.5	C
4. Winton Parkway / SR 99 SB Ramps	Signalized	C	AM	14.8	B	15.3	B	15.1	B
			PM	23.0	C	26.4	C	23.5	C
5. Hammatt Avenue / SR 99 NB Ramps	Signalized	C	AM	15.8	B	28.3	C	19.5	B
			PM	11.8	B	15.6	B	14.3	B
6. Hammatt Avenue / SR 99 SB Ramps	Signalized	C	AM			22.0	C	19.8	B
			PM			23.4	C	25.3	C

DELAY is measured in seconds
LOS = Level of Service / **BOLD** denotes LOS standard has been exceeded

1.0 Introduction

1.1 Description of the Region/Project

This Traffic Impact Study (TIS) has been prepared for the purpose of analyzing traffic conditions related to the proposed development of an industrial-commercial project with approximately 22 lots. The Project site is located in the northern portion of the City of Livingston along Bird Street. Figures 1-1 and 1-2 graphically display the location of the Project and the surrounding roadway network. Figure 1-3 provides the site map for the Project.

1.1.1 *Project Access*

The access/egress from the site will be located along Bird Street, approximately one-half mile west of the Bird Street and Livingston Cressey Road intersection. The site map includes two (2) driveways or access/egress points from Bird Street.

1.1.2 *Study Area*

The following intersections and roadway segments included in this TIS were determined in consultation with City of Livingston staff and include:

Intersections

- ✓ Bird Street at Livingston Cressey Road
- ✓ Campbell Boulevard at Main Street
- ✓ Winton Parkway at SR 99 NB Ramps
- ✓ Winton Parkway at SR 99 SB Ramps
- ✓ Hammatt Avenue at SR 99 NB Ramps
- ✓ Hammatt Avenue at SR 99 SB Ramps

Roadway Segments

- ✓ Bird Street between:
  - Livingston Cressey Road and Project Driveway
- ✓ Main Street between:
  - Bird Street and Campbell Boulevard

1.1.3 *Study Scenarios*

The TIS completed for the proposed Project includes level of service (LOS) analysis for the following traffic scenarios:

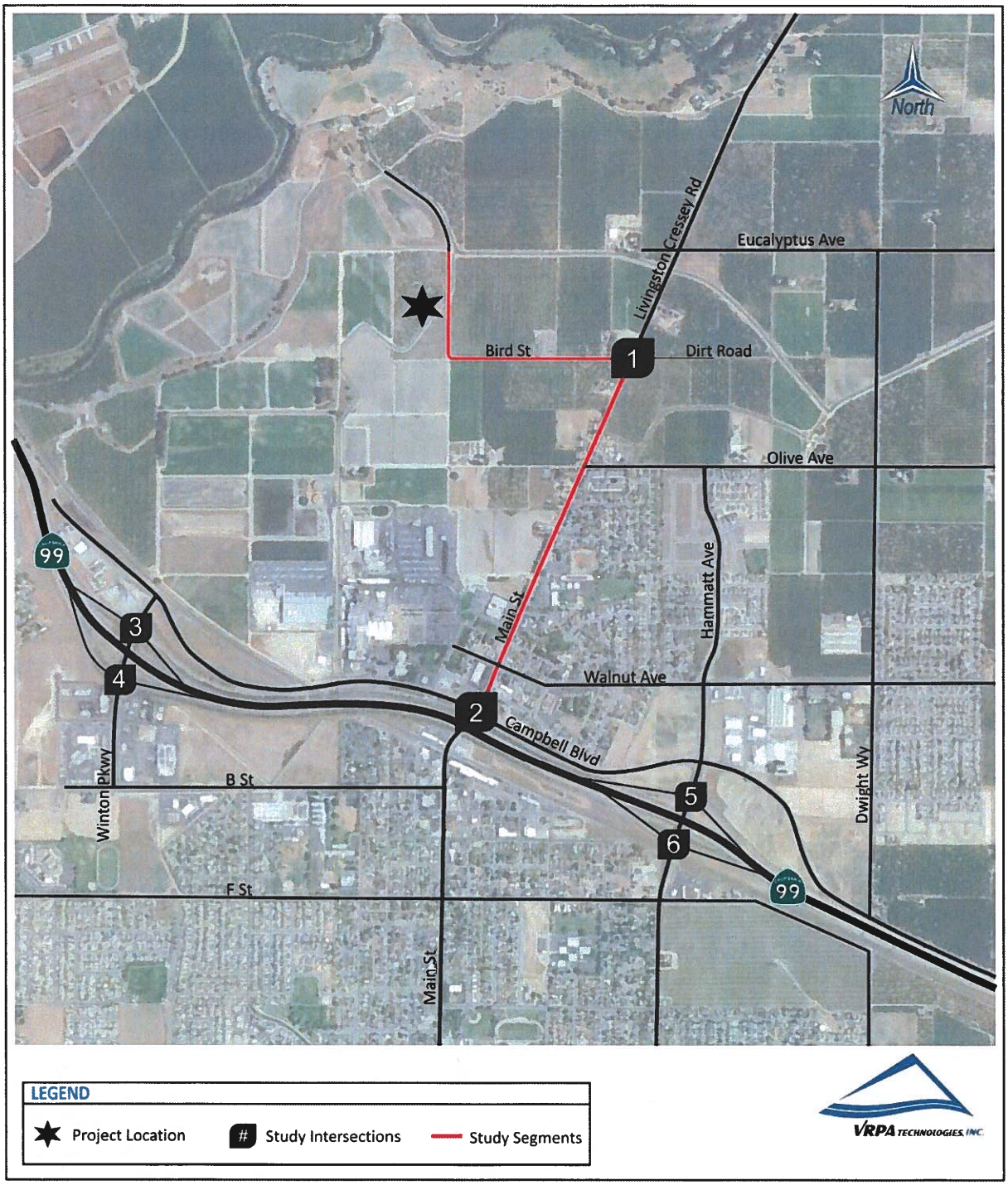
- ✓ Existing
- ✓ Existing Plus Project
- ✓ Near-Term (Project Opening Day) Plus Project
- ✓ Cumulative Year 2042 Without Project
- ✓ Cumulative Year 2042 Plus Project

Greenzone Industrial Development
Regional Location

Figure 1-1

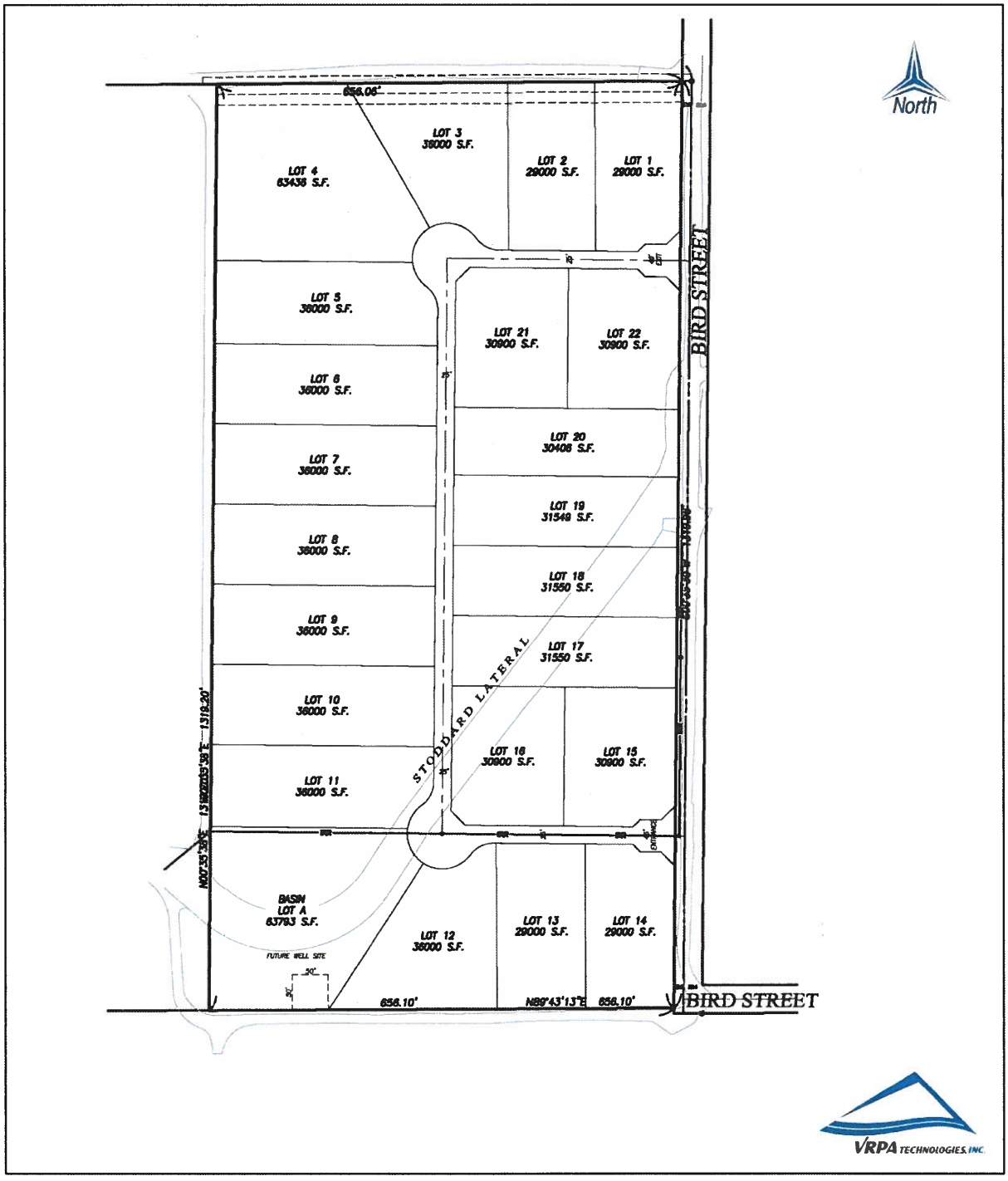
Greenzone Industrial Development
Project Location

Figure 1-2



Greenzone Industrial Development
Project Site Map

Figure 1-3



1.2 Methodology

When preparing a TIS, guidelines set by affected agencies are followed. In analyzing street and intersection capacities the Level of Service (LOS) methodologies are applied. LOS standards are applied by transportation agencies to quantitatively assess a street and highway system's performance. In addition, safety concerns are analyzed to determine the need for appropriate mitigation resulting from increased traffic near sensitive uses and other evaluations such as the need for signalized intersections or other improvements.

1.2.1 *Intersection Analysis*

Intersection LOS analysis was conducted using the Synchro 10 software program. Synchro 10 supports the Highway Capacity Manual (HCM) 6th Edition methodologies and is an acceptable program for assessment of traffic impacts. Levels of Service can be determined for both signalized and unsignalized intersections. All of the study intersections are currently unsignalized.

Tables 1-1 and 1-2 indicate the ranges in the amounts of average delay for a vehicle at signalized and unsignalized intersections for the various levels of service ranging from LOS "A" to "F".

Intersection turning movement counts and roadway geometrics used to develop LOS calculations were obtained from field review findings and count data provided from the traffic count sources identified in Section 2.1.

When an unsignalized intersection does not meet acceptable LOS standards, the investigation of the need for a traffic signal shall be evaluated. The California Manual on Uniform Traffic Control Devices (California MUTCD) introduces standards for determining the need for traffic signals. The California MUTCD indicates that the satisfaction of one or more traffic signal warrants does not in itself require the installation of a traffic signal. In addition to the warrant analysis, an engineering study of the current or expected traffic conditions should be conducted to determine whether the installation of a traffic signal is justified. The California MUTCD Peak Hour Warrant (Warrant 3) will be used, as necessary, to determine if a traffic signal is warranted at the unsignalized intersection that falls below current LOS standards.

1.2.2 *Roadway Segment Analysis*

According to the HCM, LOS is categorized by two parameters of traffic: uninterrupted and interrupted flow. Uninterrupted flow facilities do not have fixed elements such as traffic signals that cause interruptions in traffic flow. Interrupted flow facilities do have fixed elements that cause an interruption in the flow of traffic, such as stop signs and signalized intersections along arterial roads. A roadway segment is defined as a stretch of roadway generally located between signalized or controlled intersections.

Segment LOS is important in order to understand whether the capacity of a roadway can accommodate future traffic volumes. Table 1-3 provides a definition of segment LOS. The performance criteria used for evaluating volumes and capacities on the road and highway system for this study were estimated using the HCM-Based LOS Tables (Florida Tables). The tables consider the capacity of individual road and highway segments based on numerous roadway variables (design speed, passing opportunities, signalized intersections per mile, number of lanes, saturation flow, etc.). Street segment capacity was determined using information shown in Table 1-4 based on the Level of Service Tables included in Appendix A.

1.3 Policies to Maintain Level of Service

An important goal is to maintain acceptable levels of service along the highway, street, and road network. To accomplish this, the City of Livingston has adopted minimum levels of service in an attempt to control congestion that may result as new development occurs.

The City of Livingston has defined LOS C as the minimum acceptable LOS at intersections and roadway segments for use in traffic studies and environmental impact reports.

Table 1-1
Signalized Intersections Level of Service Definitions (Highway Capacity Manual)

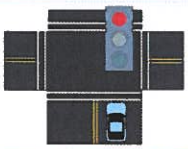
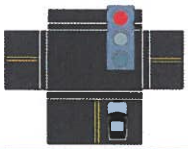
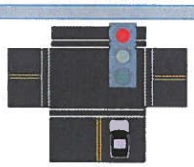
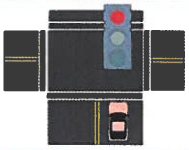
LEVEL OF SERVICE	DEFINITION		AVERAGE TOTAL DELAY (sec/veh)
A	Describes operations with very low delay. This level of service occurs when there is no conflicting traffic for a minor street.		≤ 10.0
B	Describes operations with moderately low delay. This level generally occurs with a small amount of conflicting traffic causing higher levels of average delay.		> 10.0 - 20.0
C	Describes operations with average delays. These higher delays may result from a moderate amount of minor street traffic. Queues begin to get longer.		> 20.0 - 35.0
D	Describes a crowded operation, with below average delays. At level D, the influence of congestion becomes more noticeable. Longer delays may result from shorter gaps on the mainline and an increase of minor street traffic. The queues of vehicles are increasing.		> 35.0 - 55.0
E	Describes operations at or near capacity. This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor gaps for the minor street to cross and large queues.		> 55.0 - 80.0
F	Describes operations that are at the failure point. This level, considered to be unacceptable to most drivers, often occurs with over- saturation, that is, when arrival flow rates exceed the capacity of the intersection. Insufficient gaps of suitable size exist to allow minor traffic to cross the intersection safely.		> 80.0

Table 1-2
Unsignalized Intersections Level of Service Definitions (Highway Capacity Manual)

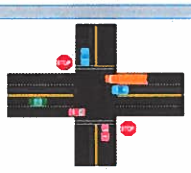
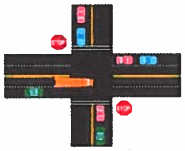
LEVEL OF SERVICE	DEFINITION	AVERAGE TOTAL DELAY (sec/veh)
A	No delay for stop-controlled approaches. 	0 - 10.0
B	Describes operations with minor delay. 	> 10.0 - 15.0
C	Describes operations with moderate delays. 	> 15.0 - 25.0
D	Describes operations with some delays. 	> 25.0 - 35.0
E	Describes operations with high delays and long queues. 	> 35.0 - 50.0
F	Describes operations with extreme congestion, with very high delays and long queues unacceptable to most drivers. 	> 50.0

Table 1-3
Roadway Segment Level of Service Definitions
(Highway Capacity Manual)

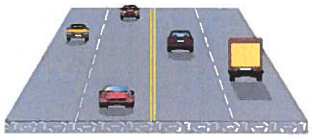
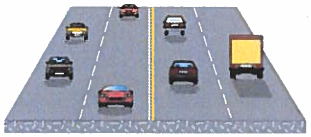
LEVEL OF SERVICE	DEFINITION	
A	Represents free flow. Individual vehicles are virtually unaffected by the presence of others in the traffic stream.	
B	Is in the range of stable flow, but the presence of other vehicles in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver.	
C	Is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual vehicles becomes significantly affected by interactions with other vehicles in the traffic stream.	
D	Is a crowded segment of roadway with a large number of vehicles restricting mobility and a stable flow. Speed and freedom to maneuver are severely restricted, and the driver experiences a generally poor level of comfort and convenience.	
E	Represents operating conditions at or near the level capacity. All speeds are reduced to a low, but relatively uniform value. Small increases in flow will cause breakdowns in traffic movement.	
F	Is used to define forced or breakdown flow (stop-and-go gridlock). This condition exists when the amount of traffic approaches a point where the amount of traffic exceeds the amount that can travel to a destination. Operations within the queues are characterized by stop and go waves, and they are extremely unstable.	

Table 1-4
Peak One-Way Volumes

Level of Service					
Lanes	Divided	B	C	D	E
Non-State Roadways					
1	Undivided	*	180	621	837
2	Undivided	43	1,148	1,522	1,590
2	Divided	45	1,215	1,611	1,683
3	Divided	72	1,836	2,421	2,538

*Cannot be achieved using table input value defaults.

2.0 Existing Conditions

2.1 Existing Traffic Counts and Roadway Geometrics

The first step toward assessing Project traffic impacts is to assess existing traffic conditions. Existing AM and PM peak hour turning movements were collected at study intersections by National Data and Surveying Services and All Traffic Data. Intersection turning movement counts were conducted for the peak hour periods of 7:00-9:00 AM and 4:00-6:00 PM for study intersections on Tuesday, November 5, 2019, Thursday, November 7, 2019, and Tuesday, August 23, 2016. A growth factor of 2% per year was applied to the traffic counts collected in 2016 to estimate 2019 traffic. Traffic count data worksheets are provided in Appendix B.

2.2 Existing Functional Roadway Classification System

Functional classification is the process by which streets and highways are grouped into classes, or systems, according to the type of service they are intended to provide. Fundamental to this process is the recognition that individual streets and highways do not serve travel independently in any major way. Rather, most travel involves movement through a network of roads.

The current hierarchical system of roadways within the study area consists of the following four (4) basic classifications:

- ✓ **State Freeways and Highways** – provide for the ability to carry large traffic volumes at high speeds for long distances. Access points are fully controlled. Freeways connect points within the City/County and link the City/County to other parts of the State.
- ✓ **Arterials** – provide for mobility within the City/County, carrying through traffic on continuous routes and joining major traffic generators, freeways, and other arterials. Access to abutting private property and intersecting local streets shall generally be restricted.
- ✓ **Collectors** – provide for internal traffic movement within communities and connect local roads to arterials. Direct access to abutting private property shall generally be permitted.
- ✓ **Local Streets** – Roadways which provide direct access to abutting property and connect with other local roads, collectors, and arterials. Local roads are typically developed as two-lane undivided roadways. Access to abutting private property and intersecting streets shall be permitted.

2.3 Affected Streets and Highways

Major street and highway intersections and segments in the Project Area were analyzed to determine levels of service utilizing HCM-based methodologies described previously. The study intersections and street and highway segments included in this TIS are listed below.

Intersections

- ✓ Bird Street at Livingston Cressey Road

- ✓ Campbell Boulevard at Main Street
- ✓ Winton Parkway at SR 99 NB Ramps
- ✓ Winton Parkway at SR 99 SB Ramps
- ✓ Hammatt Avenue at SR 99 NB Ramps
- ✓ Hammatt Avenue at SR 99 SB Ramps

Roadway Segments

- ✓ Bird Street between:
  - Livingston Cressey Road and Project Driveway
- ✓ Main Street between:
  - Bird Street and Campbell Boulevard

The existing lane geometry at study area intersections and roadway segments is shown in Figure 2-1. All of the study intersections are currently unsignalized. Figures 2-2 and 2-3 shows existing traffic volumes for the Weekday AM and PM peak hours in the study area.

2.4 Level of Service

2.4.1 *Intersection Capacity Analysis*

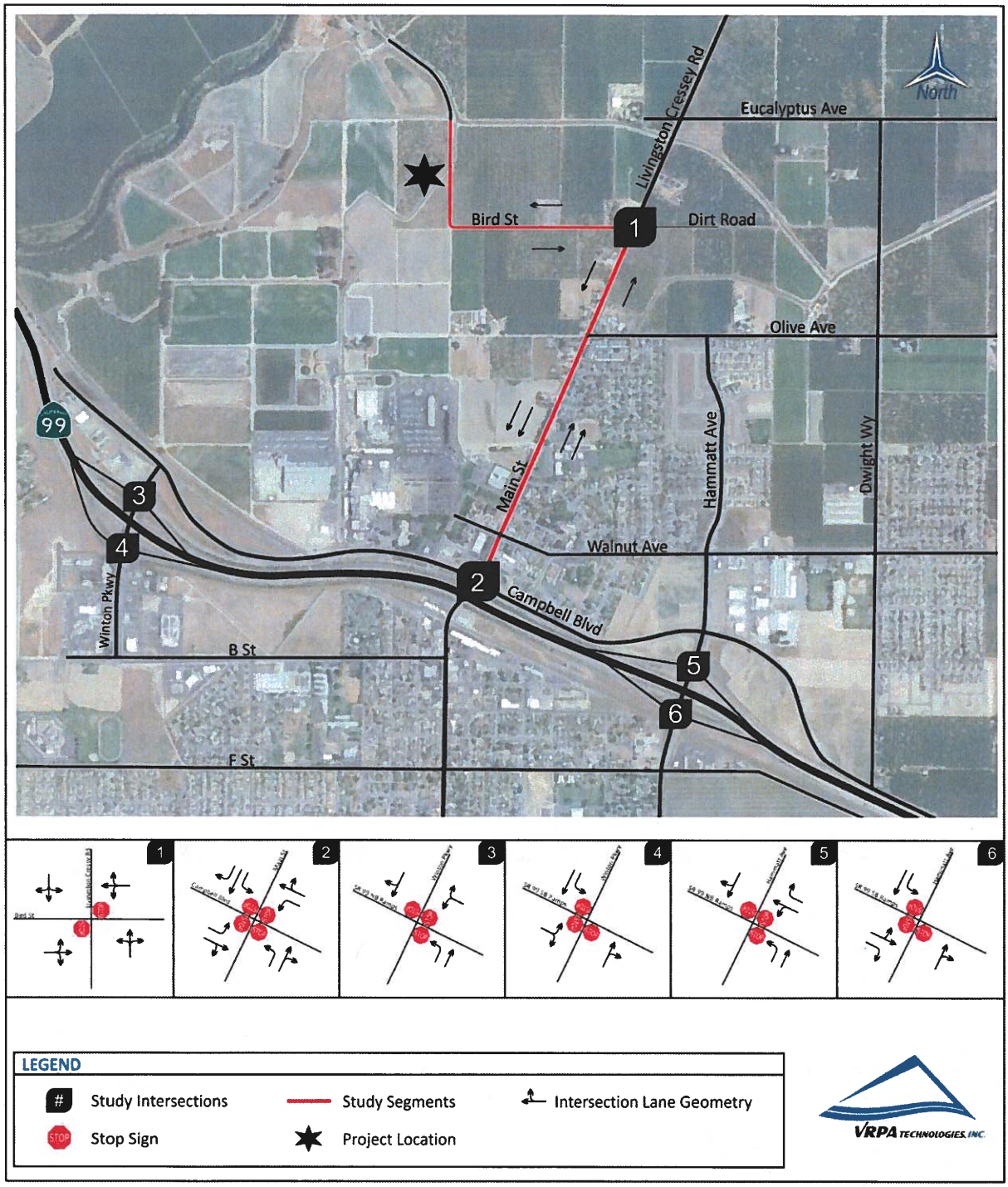
All intersection LOS analyses were estimated using the Synchro 10 software program. Various roadway geometrics, traffic volumes, and properties (peak hour factors, storage pocket length, etc.) were input into the Synchro 10 software program in order to accurately determine the travel delay and LOS for each Study scenario. The intersection LOS and delays reported represent the HCM 6th Edition outputs. Synchro assumptions, listed below, show the various Synchro inputs and methodologies used in the analysis.

- ✓ **Traffic Conditions**
  - The peak hour factor (PHF) used for Existing, Existing Plus Project, and Near-Term conditions was determined from the existing counts.
  - Roadway link speed limits will be observed in the field and input into the Synchro network to determine roadway link speeds.
  - Existing left- and right-turn storage pockets will be measured from aerial photography and incorporated into the synchro analysis.
  - Heavy vehicle percentages were applied as follows and are based on the HCM default:
    - All roadways – 3%

Results of the analysis show that the Campbell Boulevard at Main Street, Winton Parkway at SR 99 SB Ramps, and Hammatt Avenue at SR 99 NB Ramps intersections are currently operating at less than the target LOS. It should be noted that the Campbell Boulevard at Main Street intersection does not currently meet CA MUTCD Warrant 3 (Peak Hour). Table 2-1 shows the intersection LOS for existing conditions. Synchro 10 (HCM 6th Edition) Worksheets are provided in Appendix C.

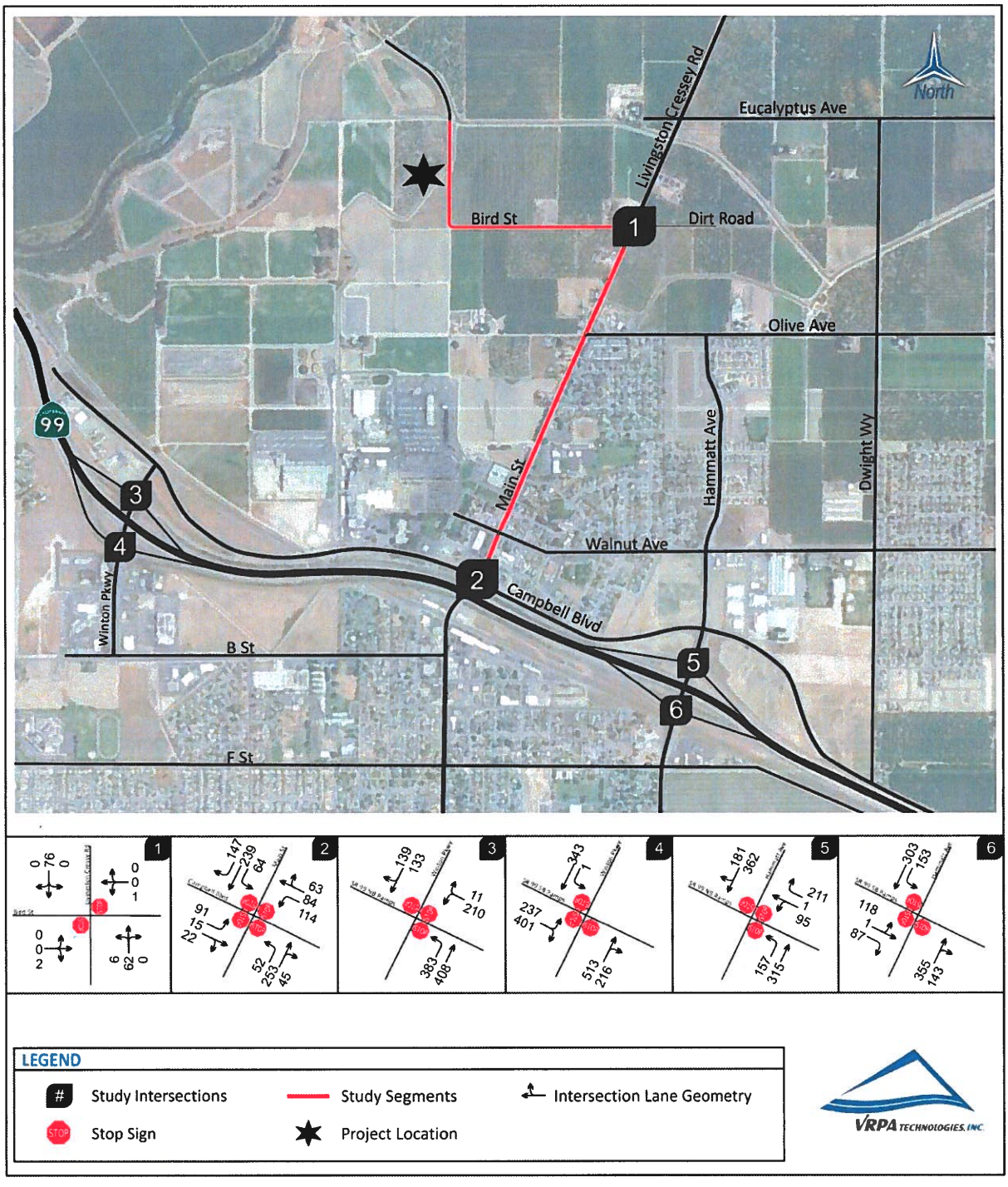
Greenzone Industrial Development
Existing Lane Geometry

Figure 2-1



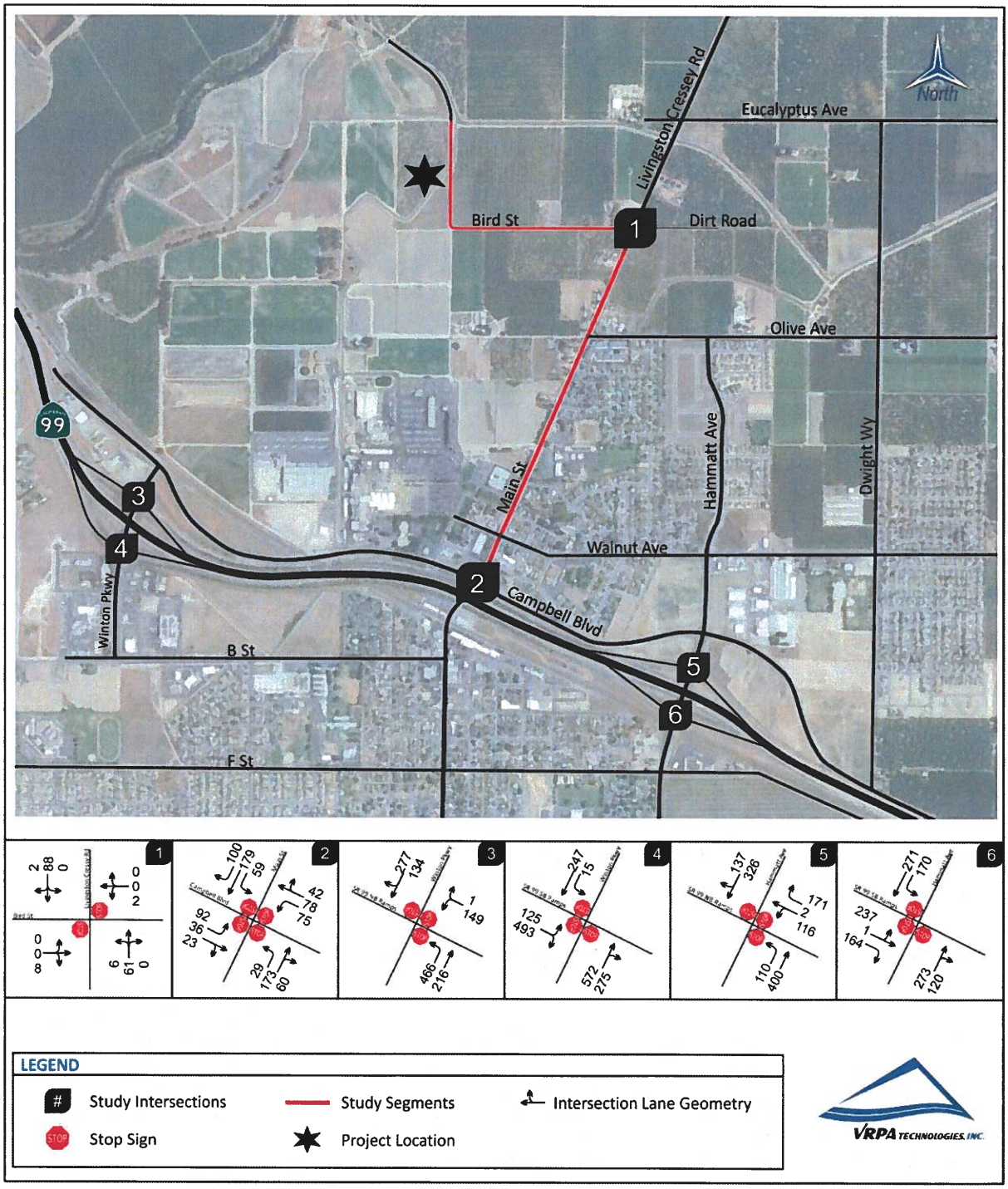
Greenzone Industrial Development
Existing AM Peak Hour Traffic

Figure 2-2



Greenzone Industrial Development
Existing PM Peak Hour Traffic

Figure 2-3



2.4.2 *Queuing Analysis*

Table 2-2 provides a queue length summary for study intersections for the Existing scenario. Traffic queue lengths at an intersection or along a roadway segment assist in the determination of a roadway's overall performance. Excessive queuing at an intersection increases vehicle delay and reduces capacity. If a dedicated left turn lane doesn't provide adequate storage, vehicles will queue beyond the left turn storage pocket and into other travel lanes, thus increasing vehicle delay and reducing capacity. The queuing analyses is based upon methodology presented in Chapter 400 of Caltrans' Highway Design Manual (HDM).

2.4.3 *Roadway Segment Capacity Analysis*

Peak hour LOS segment analysis along the existing street and highway system are reflected in Table 2-3. The performance criteria used for evaluating volumes and capacities on the road and highway system for this study were estimated using the Arterial Level of Service Tables included in Table 1-4 and Appendix A. Results of the analysis show that all of the study roadway segments are currently operating at the target LOS during the AM and PM peak hour.

Table 2-1
Existing Intersection Operations

INTERSECTION	CONTROL	TARGET LOS	PEAK HOUR	EXISTING	
				DELAY	LOS
1. Livingston Cressey Road / Bird Street	One-Way Stop	C	AM	9.7	A
			PM	10.0	B
2. Main Street / Campbell Boulevard	All-Way Stop	C	AM	**38.3**	**E +**
			PM	13.8	B
3. Winton Parkway / SR 99 NB Ramps	All-Way Stop	C	AM	16.1	C
			PM	22.3	C
4. Winton Parkway / SR 99 SB Ramps	All-Way Stop	C	AM	**169.8**	**F ++**
			PM	**191.2**	**F ++**
5. Hammatt Avenue / SR 99 NB Ramps	All-Way Stop	C	AM	**37.0**	**E ++**
			PM	**26.5**	**D ++**
6. Hammatt Avenue / SR 99 SB Ramps	All-Way Stop	C	AM	23.6	C
			PM	20.0	C

DELAY is measured in seconds

LOS = Level of Service / **BOLD** denotes LOS standard has been exceeded

For All-Way Stop intersections, delay results show the average for the entire intersection. For one-way stop controlled intersections, delay results show the delay for the worst movement.

+ Does not meet peak hour signal warrants.

++ Meets peak hour signal warrants.

Table 2-2
Existing Queuing Operations

INTERSECTION	EXISTING QUEUE STORAGE LENGTH (ft)		EXISTING CONDITIONS	
			AM Queue	PM Queue
Main Street / Campbell Boulevard	NB Left	150	43	24
	SB Left	100	53	49
	EB Left	200	76	77
	WB Left	150	95	63
	WB Right	75	**168**	**165**
Winton Parkway / SR 99 NB Ramps	NB Left	175	**319**	**388**
Winton Parkway / SR 99 SB Ramps	SB Left	200	1	13
Hammatt Avenue / SR 99 NB Ramps	NB Left	150	131	92
Hammatt Avenue / SR 99 SB Ramps	SB Left	125	**128**	**142**

Queue is measured in feet / **BOLD** denotes exceedance

Table 2-3
Existing Segment Operations

STREET SEGMENT	SEGMENT DESCRIPTION	DIRECTION	TARGET LOS	PEAK HOUR	EXISTING	
					VOLUME	LOS
Bird Street						
Livingston Cressey Road to Project Driveway	2 Lanes Undivided	EB	C	AM	2	C
				PM	8	C
		WB		AM	6	C
				PM	8	C
Main Street						
Bird Street to Olive Avenue	2 Lanes Undivided	NB	C	AM	68	C
				PM	67	C
		SB		AM	79	C
				PM	98	C
Olive Avenue to Campbell Boulevard	4 Lanes Undivided	NB	C	AM	407	C
				PM	307	C
		SB		AM	450	C
				PM	338	C

LOS = Level of Service / **BOLD** denotes LOS standard has been exceeded

3.0 Traffic Impacts

This chapter provides an assessment of the traffic the Project is expected to generate and the impact of that traffic on the surrounding street system.

3.1 Trip Generation

To assess the impacts that the Project may have on the surrounding street and highway segments and intersections, the first step is to determine Project trip generation. The Project's trip generation was estimated based on trip generation rates from the Institute of Transportation Engineers (ITE) Trip Generation Manual (10th Edition). The Project's estimated Daily, AM peak hour, and PM peak hour trips are shown in Table 3-1. Trips associated with the Greenzone Industrial Development were derived from the High Cube Transload and Short-Term Storage (154) Land Use in the ITE Trip Generation Manual.

Table 3-1
Project Trip Generation

LAND USE	Quantity	DAILY TRIP ENDS (ADT)		WEEKDAY AM PEAK HOUR					WEEKDAY PM PEAK HOUR				
		RATE	VOLUME	RATE	IN:OUT SPLIT	VOLUME			RATE	IN:OUT SPLIT	VOLUME		
						IN	OUT	TOTAL			IN	OUT	TOTAL
High Cube Transload and Short-Term Storage (154)	376,000 s.f	1.399	526	0.08	77:23	23	7	30	0.10	29:71	11	27	38
TOTAL TRIP GENERATION			**526**			**23**	**7**	**30**			**11**	**27**	**38**

Source: Generation factors from ITE Trip Generation Manual, 10th Edition.
Trip ends are one-way traffic movements, entering or leaving.
The numbers in parenthesis are ITE land use codes.

3.2 Trip Distribution

Project trip distribution is shown in Figure 3-1 and is based upon engineering judgement, prevailing traffic patterns in the study area, complementary land uses, major routes, population centers and customer base.

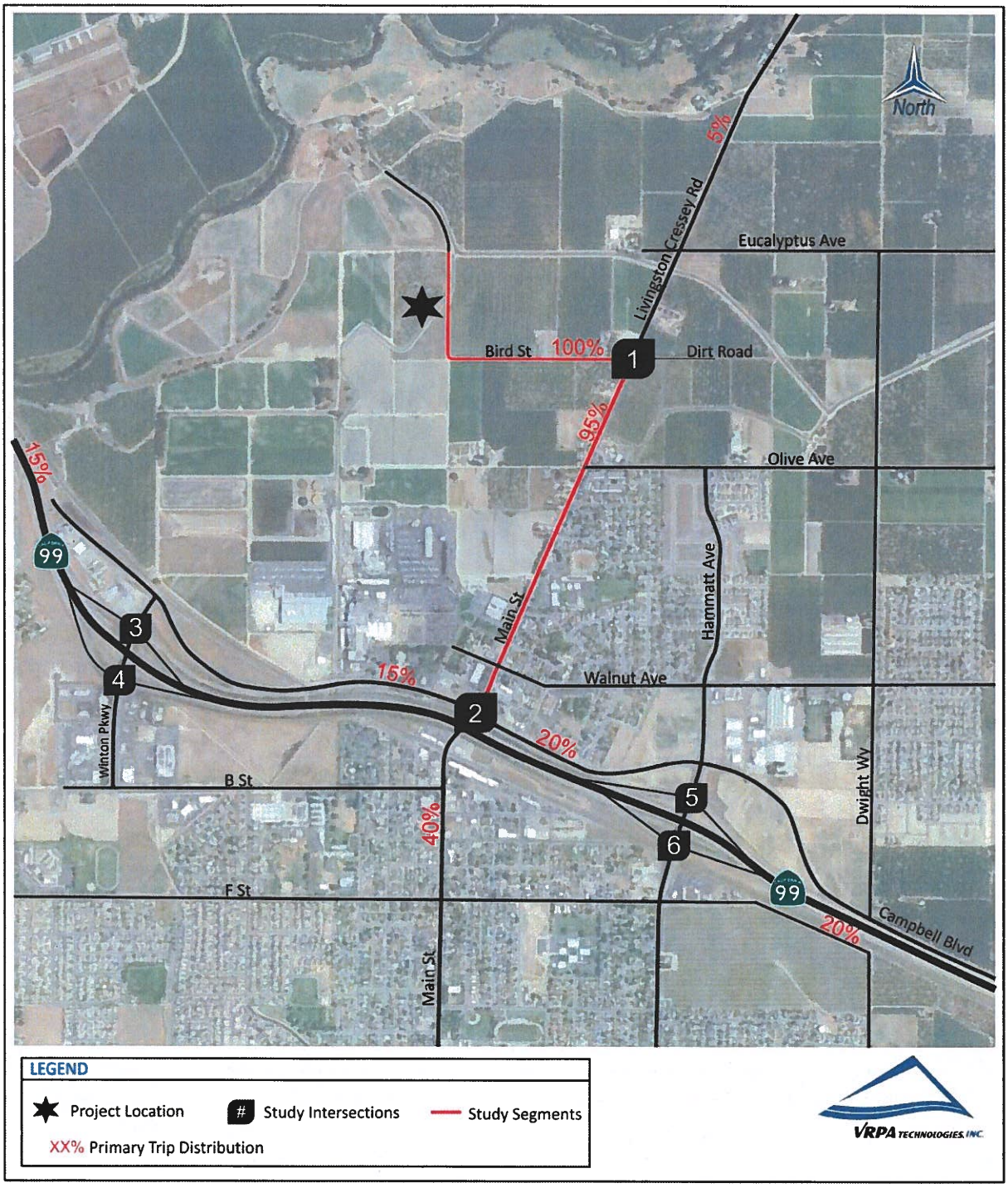
The access/egress from the site will be located along Bird Street, approximately one-half mile west of the Bird Street and Livingston Cressey Road intersection. The site map includes two (2) driveways or access/egress points from Bird Street.

3.3 Project Traffic

Project traffic as shown in Table 3-1 was distributed to the roadway system using the trip distribution percentages shown in Figure 3-1. A graphical representation of the resulting AM and PM peak hour Project trips is shown in Figures 3-2 and 3-3.

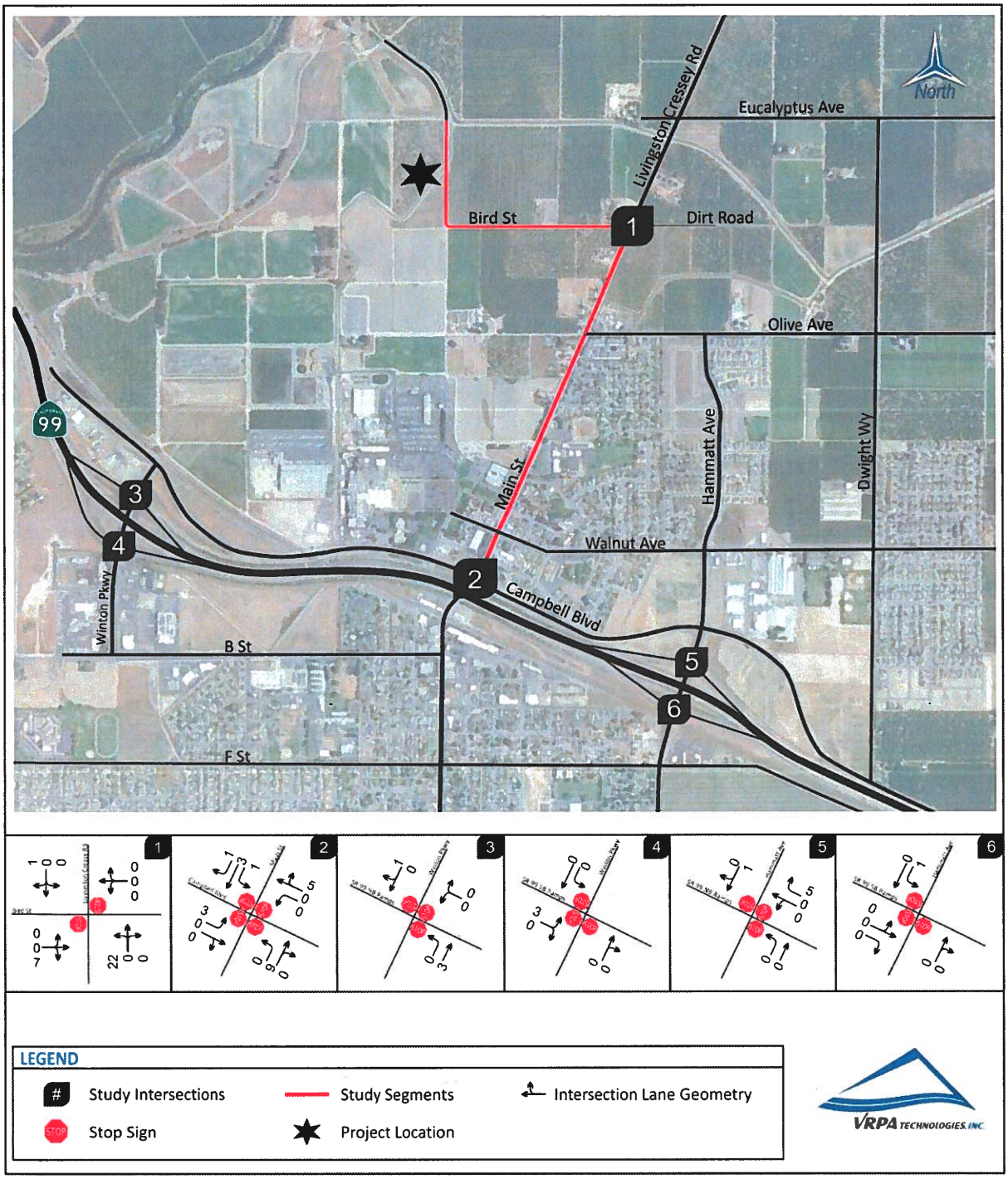
Greenzone Industrial Development
Project Trip Distribution

Figure 3-1



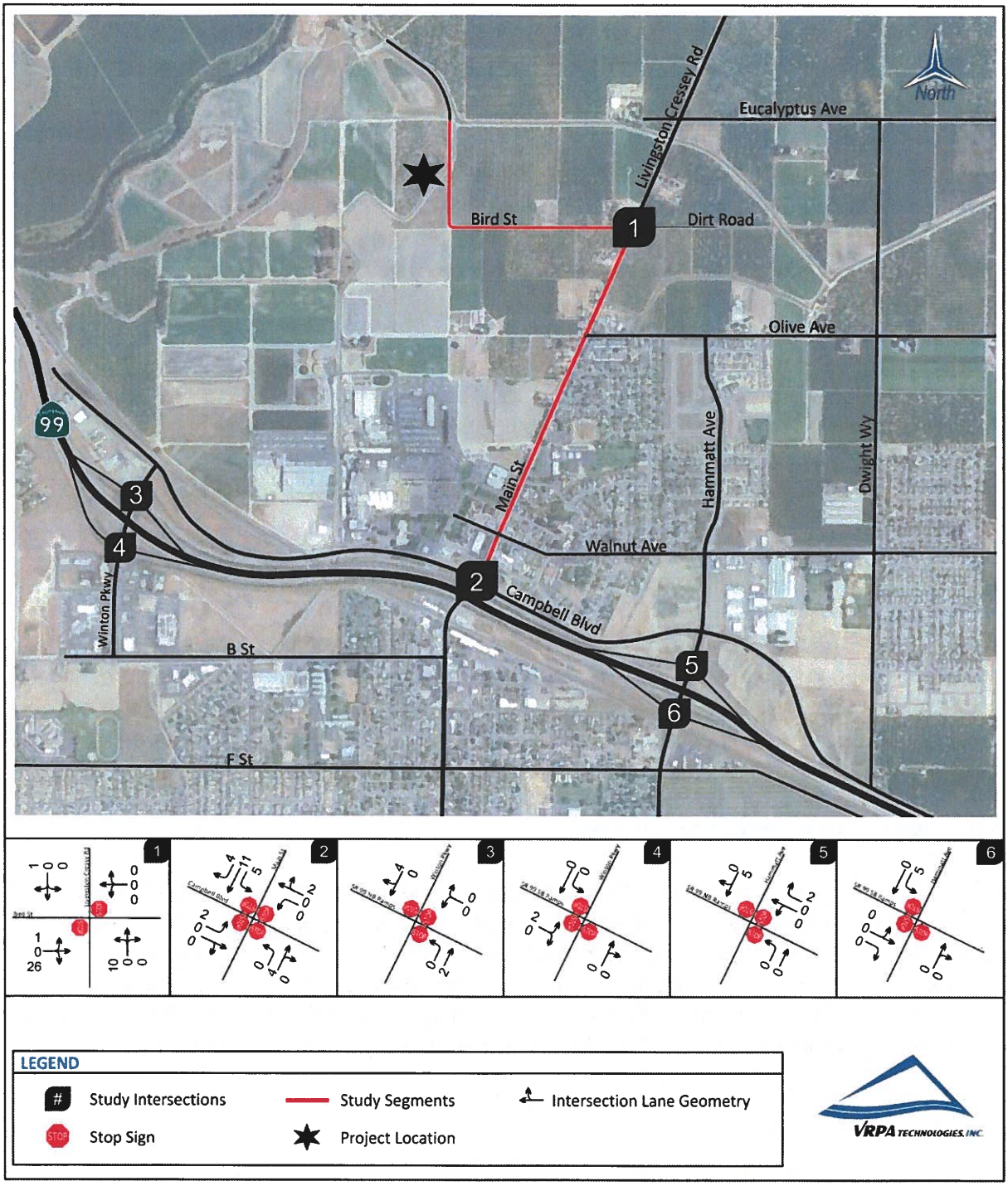
Greenzone Industrial Development
Project AM Peak Hour Traffic

Figure 3-2



Greenzone Industrial Development
Project PM Peak Hour Traffic

Figure 3-3



3.4 Existing Plus Project Traffic Conditions

An Existing Plus Project Scenario was analyzed to include existing traffic plus traffic generated by the Project. The resulting traffic is shown in Figures 3-4 and 3-5.

3.5 Approved/Pending Project Traffic

Traffic impact analyses typically require the analysis of approved or pending developments that have not yet been built in the vicinity of the Project in addition to the proposed Project. City of Livingston staff was consulted for approved or pending developments in the area. The approved and/or pending projects in the study area consist of the following projects:

- ✓ Padilla's Car Sales – Used Car Lot
- ✓ Legacy Homes – 100 single family dwelling units remaining
- ✓ Arco Development – Gas Station
- ✓ Bright Development – 35 single family dwelling units remaining
- ✓ Truck Stop/Truck Wash – Formal applications yet to be submitted
- ✓ Multi-Family Residential Project – Formal applications yet to be submitted
- ✓ The Villages @ Main – 432 multi-family dwelling units
- ✓ WPD Homes – 8 single family dwelling units
- ✓ Gallo Tentative Subdivision Map
- ✓ AAA Truck Wash and Service Center

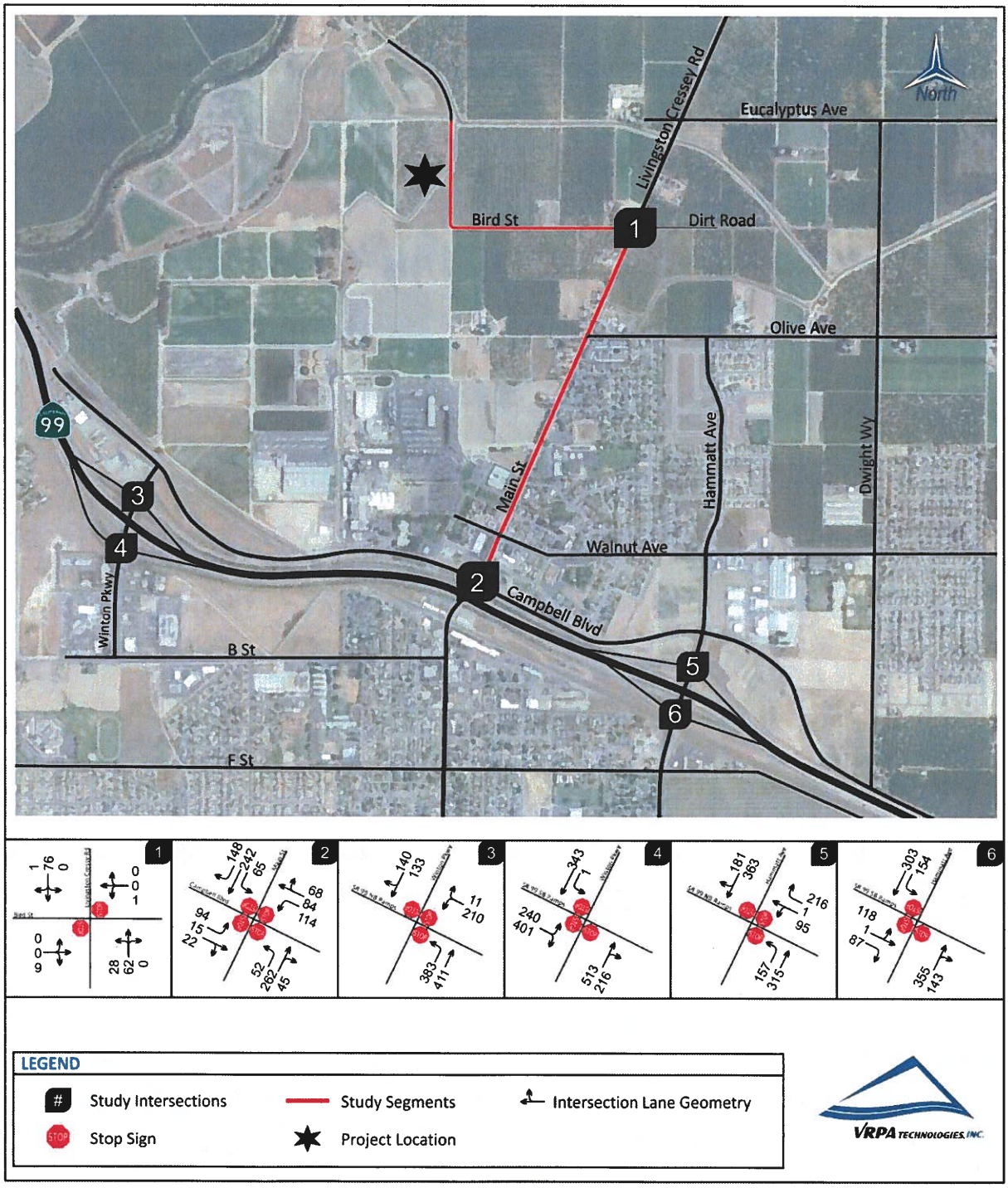
Trip generation and distribution information for the approved and pending developments was based upon the ITE Trip Generation Manual, engineering judgement, and prevailing traffic patterns. The peak hour trips for the Approved and Pending project traffic was applied to the Near-Term and Cumulative Year 2042 traffic conditions discussed later in the report.

3.6 Near-Term Traffic Conditions

A Near-Term Scenario was analyzed to include year 2022 traffic (estimated Project Opening-Day) plus traffic generated by other projects approved or being processed in the study area. Traffic conditions in the Year 2022 was estimated by using a 1.26% per year growth factor for background (ambient) growth along City of Livingston facilities. This growth rate is consistent with MCAG's 2018 Regional Transportation Plan/Sustainable Communities Strategies Environmental Impact Report. The resulting traffic is shown in Figures 3-6 and 3-7.

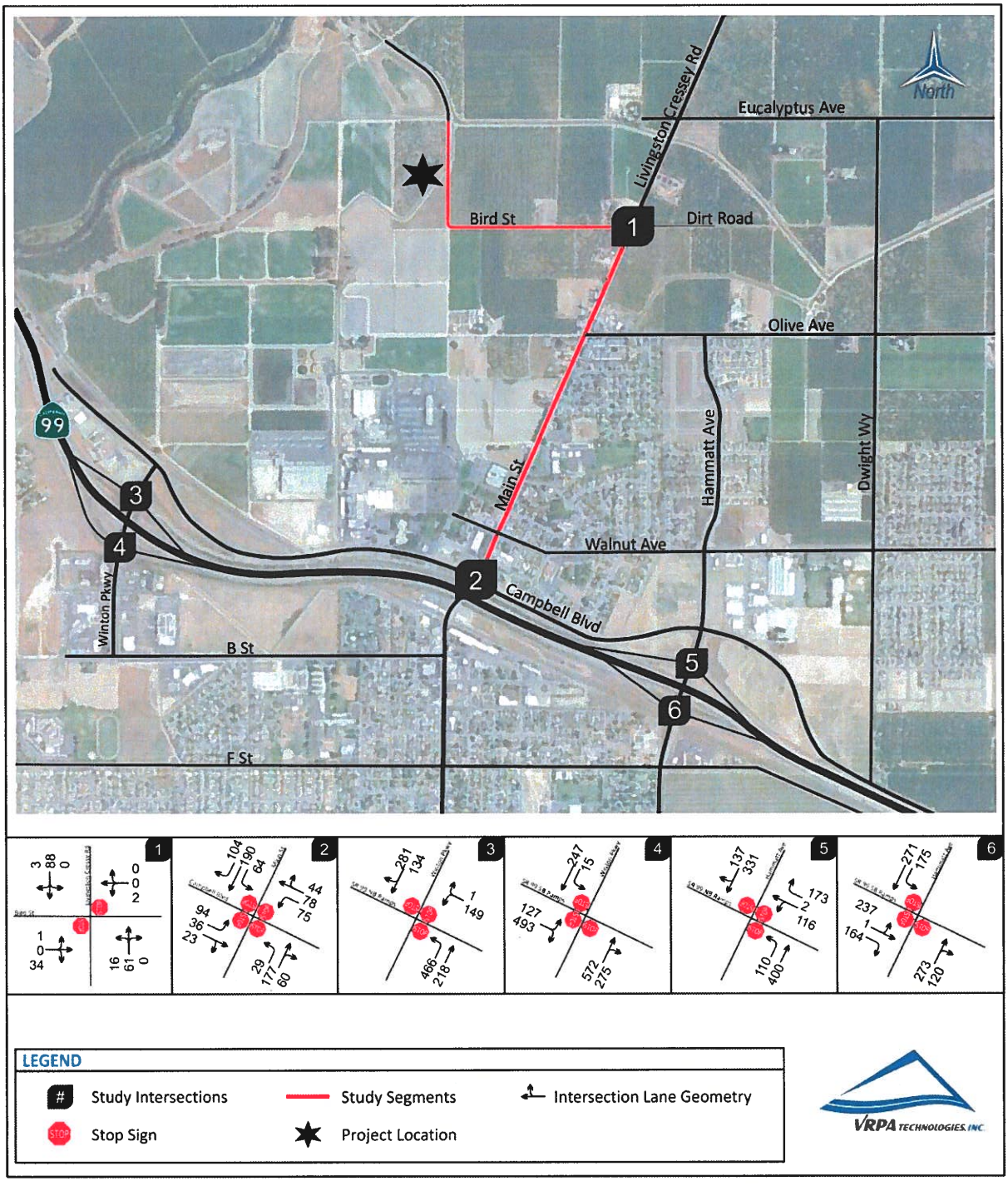
Greenzone Industrial Development
Existing Plus Project AM Peak Hour Traffic

Figure 3-4



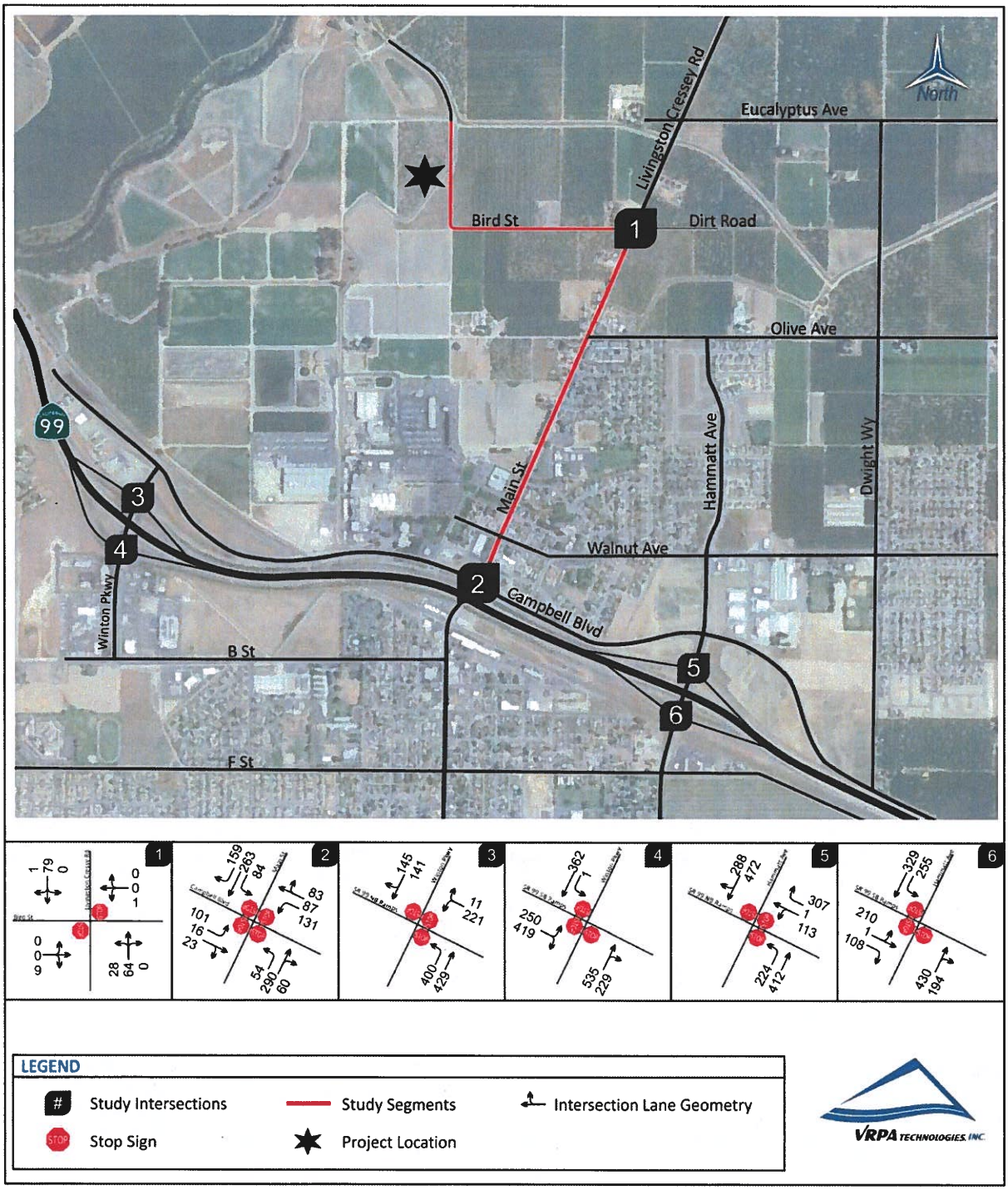
Greenzone Industrial Development
Existing Plus Project PM Peak Hour Traffic

Figure 3-5



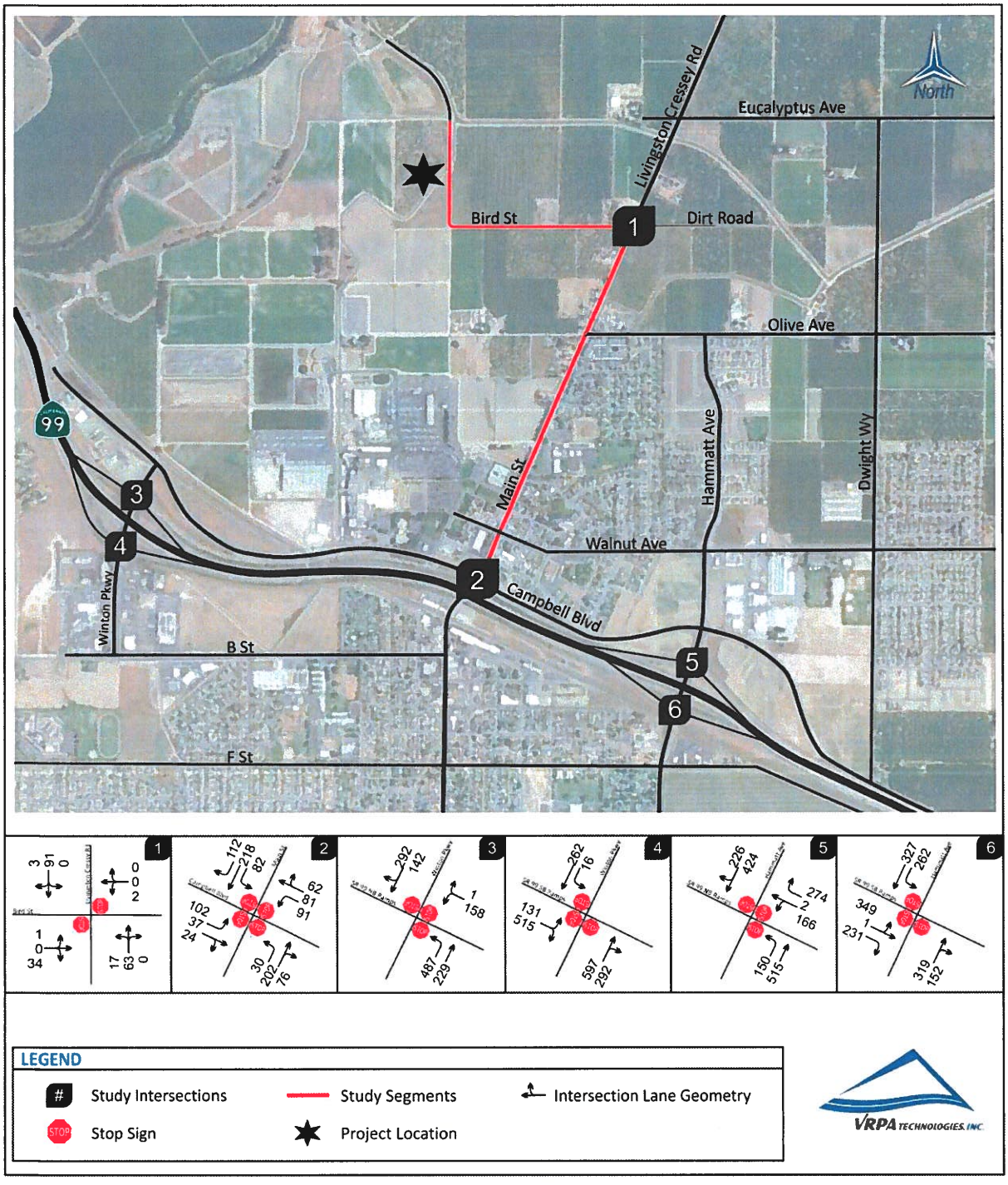
Greenzone Industrial Development
Near-Term Plus Project AM Peak Hour Traffic

Figure 3-6



Greenzone Industrial Development
Near-Term Plus Project PM Peak Hour Traffic

Figure 3-7



3.7 Cumulative Year 2042 Without Project Traffic Conditions

The impacts of the Project were analyzed considering future traffic conditions, approximately twenty (20) years after the assumed opening day of the Project, or in this case the year 2042. The levels of traffic expected in 2042 relate to the cumulative effect of traffic increases resulting from the implementation of the General Plans of local agencies, including the City of Livingston and Merced County. Traffic conditions in the Year 2042 was estimated using a 1.26% per year growth factor for background (ambient) growth, which is consistent with MCAG's 2018 Regional Transportation Plan/Sustainable Communities Strategies Environmental Impact Report. Traffic conditions resulting from this scenario are shown in Figures 3-8 and 3-9.

3.8 Cumulative Year 2042 Plus Project Traffic Conditions

The addition of Project trips, which were distributed to the roadway system using the trip distribution percentages shown in Figure 3-1 (Section 3.3), were added to Cumulative Year 2042 Without Project traffic volumes. This leads to the results shown in Figures 3-10 and 3-11.

3.9 Impacts

3.9.1 *Intersection Capacity Analysis*

Table 3-2 shows intersections that are expected to fall short of desirable operating conditions for various scenarios. Potential mitigation measures are discussed in Chapter 4 of this report. Results of the analysis show that the Project will cause or contribute to an unacceptable LOS at all of the study intersections with the exception of Livingston Cressey Road at Bird Street when comparing the Existing and Existing Plus Project scenarios and the Cumulative Year 2042 Without Project and Cumulative Year 2042 Plus Project scenarios.

3.9.2 *Queuing Analysis*

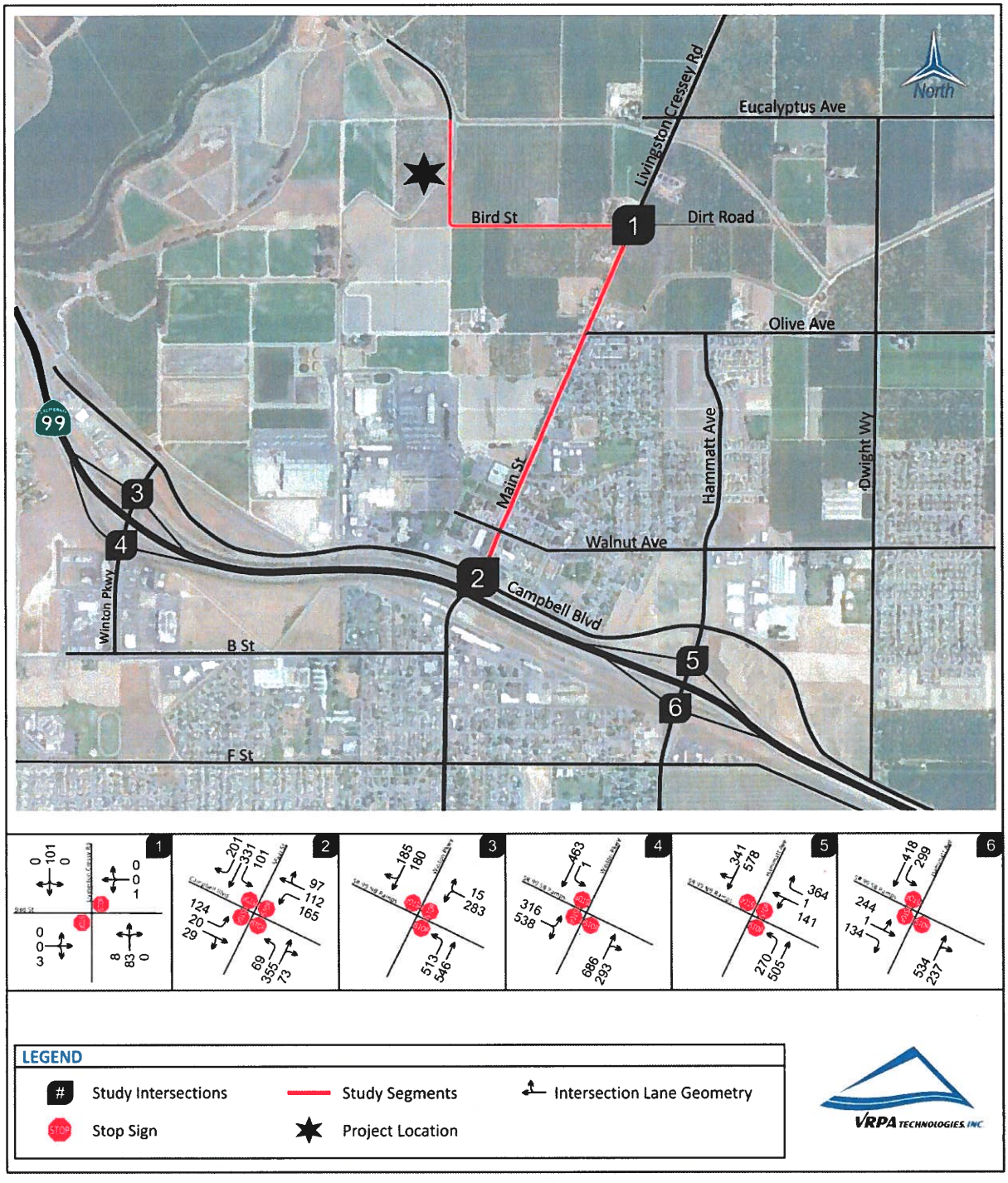
Table 3-3 provides a queue length summary for left and right turn lanes at the study intersections for various study scenarios. Queuing analysis was completed using Section 400 of Caltrans' Highway Design Manual.

3.9.3 *Roadway Segment Capacity Analysis*

Results of the segment analysis along the existing street and highway system are reflected in Table 3-4. Results of the analysis show that all of the roadway segments will operate at acceptable levels of service through the Cumulative Year 2042 Plus Project scenario.

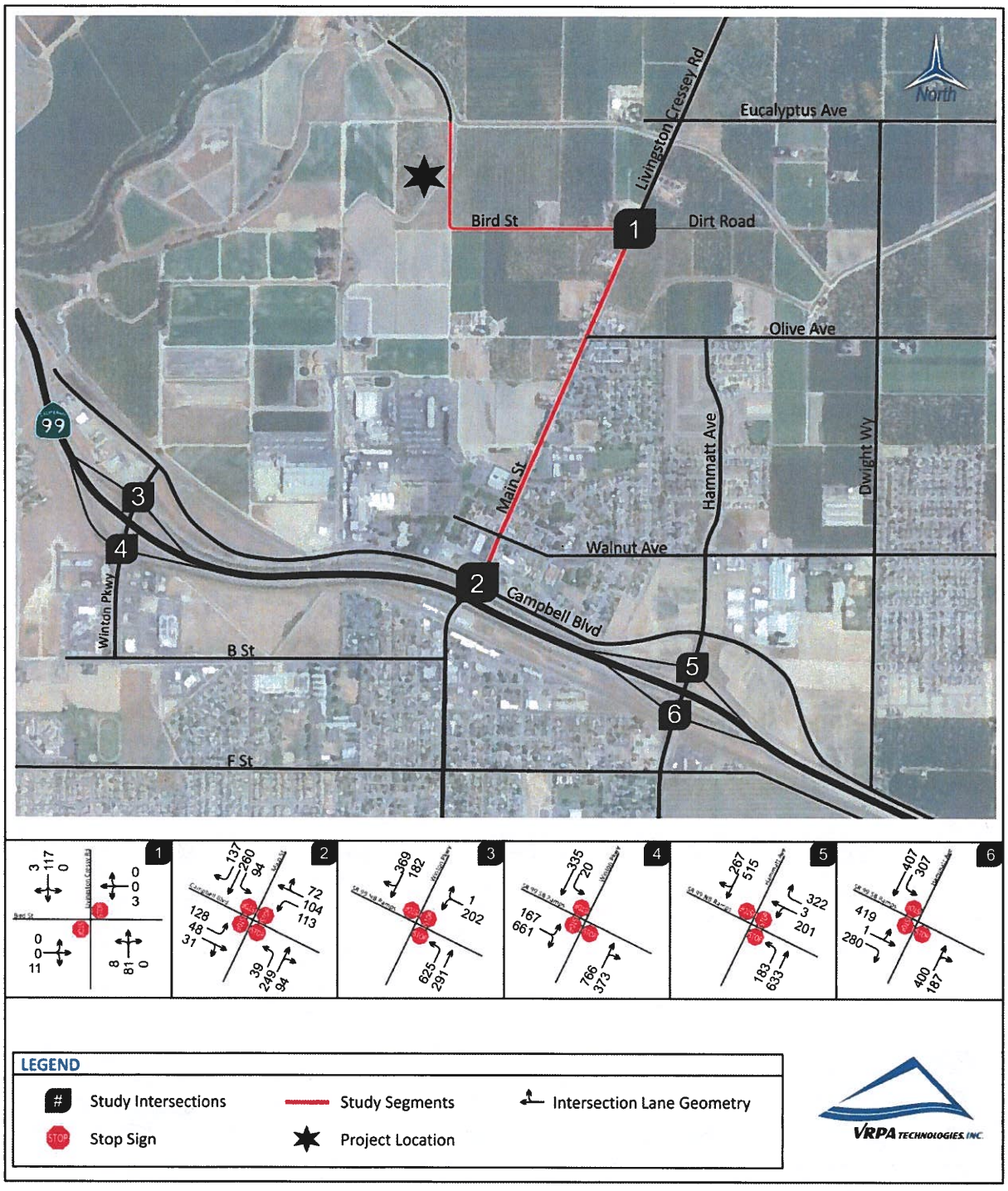
Greenzone Industrial Development
Cumulative Year 2042 Without Project AM Peak Hour Traffic

Figure 3-8



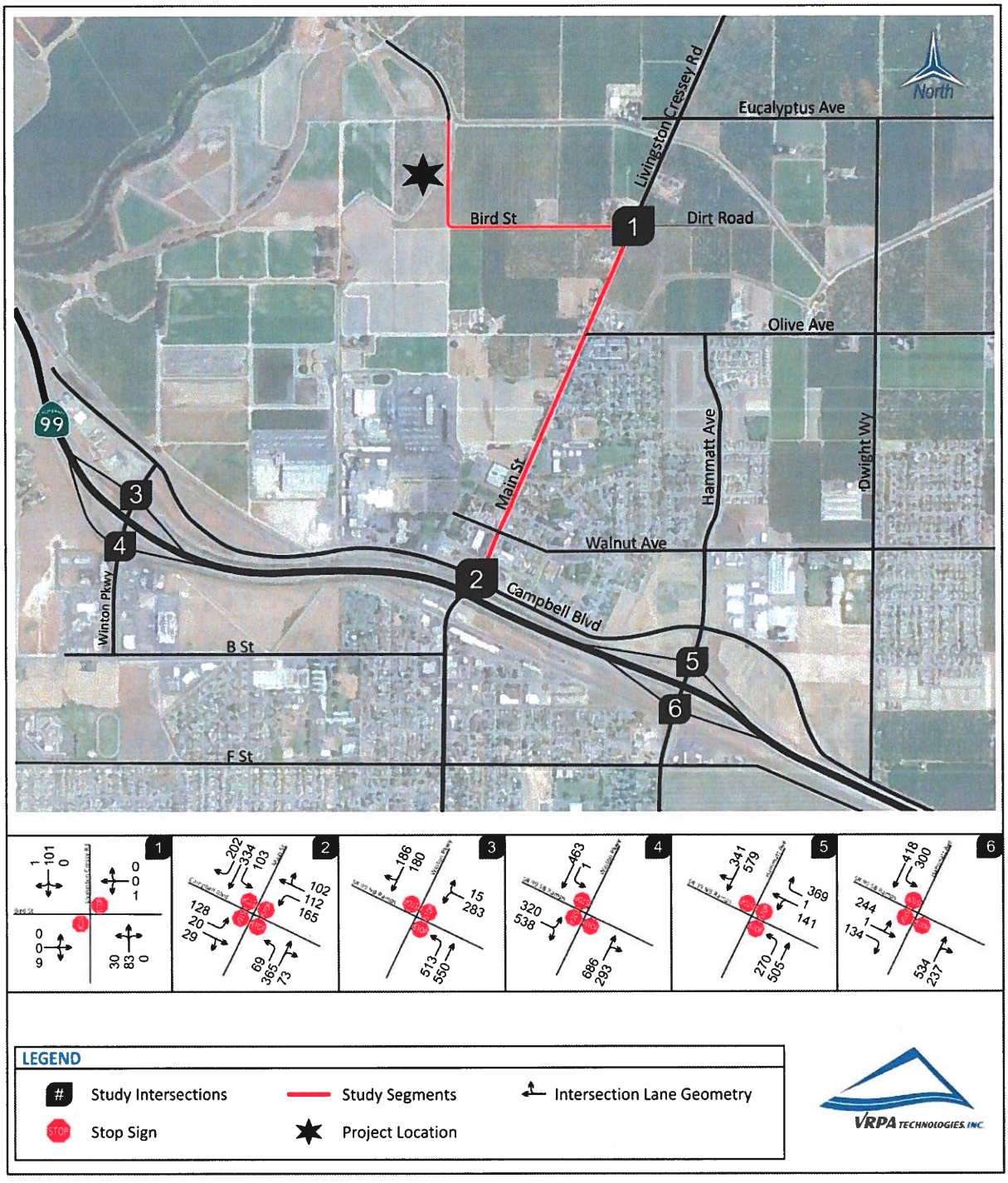
Greenzone Industrial Development
Cumulative Year 2042 Without Project PM Peak Hour Traffic

Figure 3-9



Greenzone Industrial Development
Cumulative Year 2042 Plus Project AM Peak Hour Traffic

Figure 3-10



Greenzone Industrial Development
Cumulative Year 2042 Plus Project PM Peak Hour Traffic

Figure 3-11

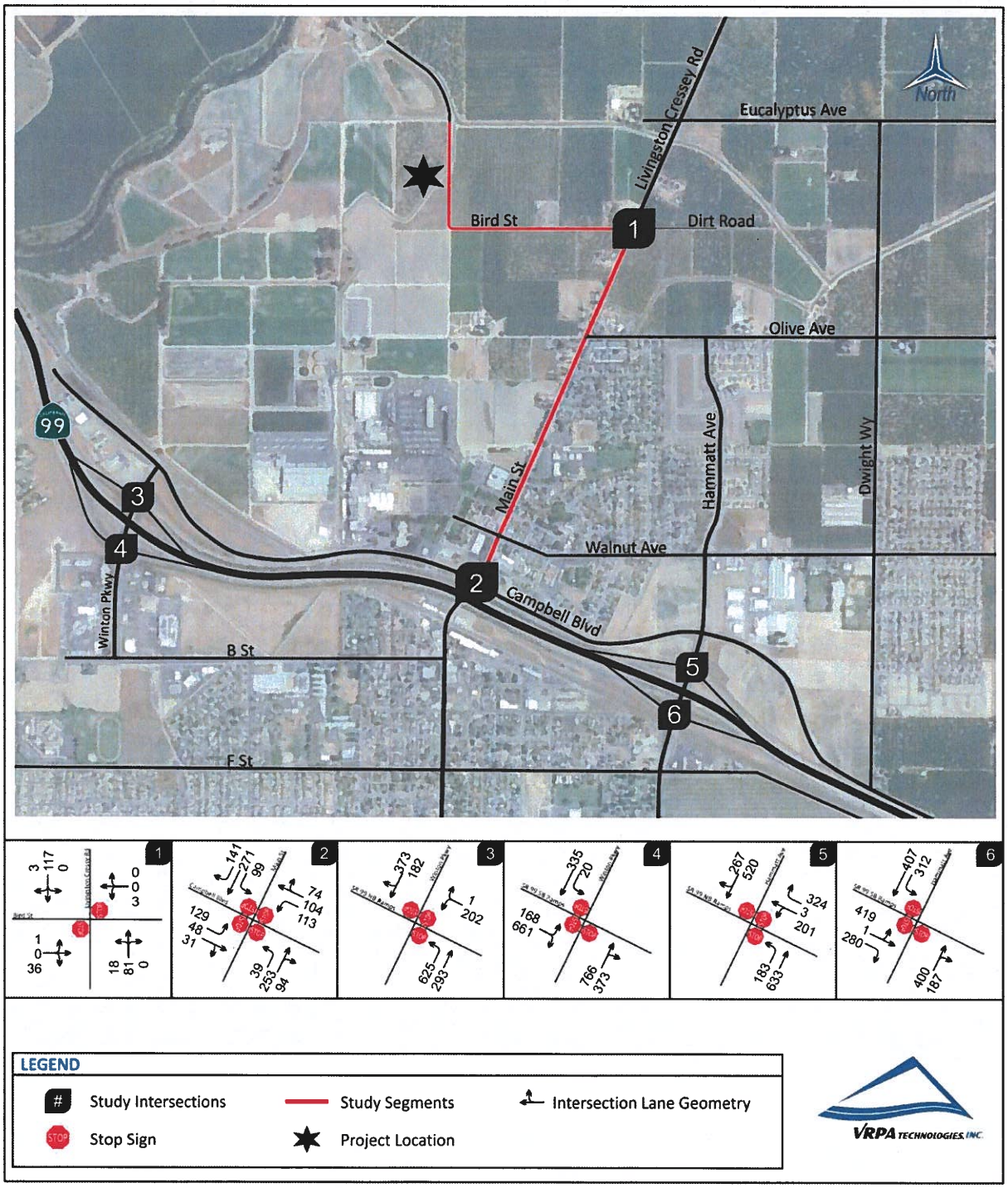


Table 3-2
Intersection Operations

INTERSECTION	CONTROL	TARGET LOS	PEAK HOUR	EXISTING PLUS PROJECT		NEAR-TERM PLUS PROJECT		CUMULATIVE YEAR 2042 WITHOUT PROJECT		CUMULATIVE YEAR 2042 PLUS PROJECT	
				DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS
1. Livingston Cressey Road / Bird Street	One-Way Stop	C	AM	10.3	B	10.4	B	10.2	B	14.8	B
			PM	10.9	B	11.0	B	10.6	B	11.6	B
2. Main Street / Campbell Boulevard	All-Way Stop	C	AM	**41.0**	**E +**	**68.1**	**F ++**	**149.4**	**F ++**	**159.3**	**F ++**
			PM	14.2	B	17.6	C	**35.5**	**E ++**	**36.8**	**E ++**
3. Winton Parkway / SR 99 NB Ramps	All-Way Stop	C	AM	19.2	C	21.4	C	**57.5**	**F ++**	**58.4**	**F ++**
			PM	22.4	C	**26.1**	**D +**	**74.9**	**F ++**	**75.3**	**F ++**
4. Winton Parkway / SR 99 SB Ramps	All-Way Stop	C	AM	**170.6**	**F ++**	**197.2**	**F ++**	**371.5**	**F ++**	**--***	**F ++**
			PM	**191.9**	**F ++**	**219.5**	**F ++**	**--***	**F ++**	**--***	**F ++**
5. Hammatt Avenue / SR 99 NB Ramps	All-Way Stop	C	AM	**37.7**	**E ++**	**136.0**	**F ++**	**226.3**	**F ++**	**227.6**	**F ++**
			PM	**27.2**	**D ++**	**104.8**	**F ++**	**193.6**	**F ++**	**196.1**	**F ++**
6. Hammatt Avenue / SR 99 SB Ramps	All-Way Stop	C	AM	23.6	C	**68.1**	**F ++**	**140.5**	**F ++**	**140.5**	**F ++**
			PM	20.0	C	**43.8**	**E ++**	**91.0**	**F ++**	**91.2**	**F ++**

DELAY is measured in seconds
LOS = Level of Service / **BOLD** denotes LOS standard has been exceeded
For All-Way Stop intersections, delay results show the average for the entire intersection. For one-way stop controlled intersections, delay results show the delay for the worst movement.
+ Does not meet peak hour signal warrants.
++ Meets peak hour signal warrants.
* Delay Exceeds 300 seconds.

Table 3-3
Queuing Operations

INTERSECTION	EXISTING QUEUE STORAGE LENGTH (ft)		EXISTING PLUS PROJECT		NEAR-TERM PLUS PROJECT		CUMULATIVE YEAR 2042 WITHOUT PROJECT		CUMULATIVE YEAR 2042 PLUS PROJECT	
			AM Queue	PM Queue	AM Queue	PM Queue	AM Queue	PM Queue	AM Queue	PM Queue
Main Street / Campbell Boulevard	NB Left	150	43	24	45	25	58	33	58	33
	SB Left	100	54	53	70	68	84	78	86	83
	EB Left	200	78	78	84	85	103	107	107	108
	WB Left	150	95	63	109	76	138	94	138	94
	WB Right	75	57	37	69	52	**81**	60	**85**	62
Winton Parkway / SR 99 NB Ramps	NB Left	175	**319**	**388**	**333**	**406**	**428**	**521**	**428**	**521**
Winton Parkway / SR 99 SB Ramps	SB Left	200	1	13	1	13	1	17	1	17
Hammatt Avenue / SR 99 NB Ramps	NB Left	150	131	92	**187**	125	**225**	**153**	**225**	**153**
Hammatt Avenue / SR 99 SB Ramps	SB Left	125	**128**	**146**	**213**	**218**	**249**	**256**	**250**	**260**

Queue is measured in feet / **BOLD** denotes exceedance

Table 3-4
Segment Operations

STREET SEGMENT	SEGMENT DESCRIPTION	DIRECTION	TARGET LOS	PEAK HOUR	EXISTING PLUS PROJECT		NEAR-TERM PLUS PROJECT		CUMULATIVE YEAR 2042 WITHOUT PROJECT		CUMULATIVE YEAR 2042 PLUS PROJECT	
					VOLUME	LOS	VOLUME	LOS	VOLUME	LOS	VOLUME	LOS
Bird Street												
Livingston Cressey Road to Project Driveway	2 Lanes Undivided	EB	C	AM	9	C	9	C	3	C	10	C
				PM	35	C	35	C	11	C	38	C
		WB		AM	29	C	29	C	8	C	31	C
				PM	19	C	19	C	11	C	22	C
Main Street												
Bird Street to Olive Avenue	2 Lanes Undivided	NB	C	AM	90	C	92	C	91	C	113	C
				PM	77	C	80	C	89	C	100	C
		SB		AM	86	C	89	C	105	C	112	C
				PM	124	C	127	C	131	C	156	C
Olive Avenue to Campbell Boulevard	4 Lanes Undivided	NB	C	AM	424	C	474	C	577	C	594	C
				PM	315	C	366	C	448	C	457	C
		SB		AM	455	C	505	C	633	C	638	C
				PM	358	C	411	C	491	C	511	C

LOS = Level of Service / **BOLD** denotes LOS standard has been exceeded

4.0 Mitigation

This chapter describes potential improvements to mitigate the traffic impacts of the Project. Described below are potential improvements at study area intersections for various scenarios. In order to mitigate the Project's impacts, the Project may be required to build improvements that are identified under the 'Existing Plus Project' condition to improve identified LOS deficiencies. The Project will be required to contribute a fair share towards the costs of improvements that are identified for the Cumulative Year 2042 scenarios.

4.1 Recommended Improvements

Intersections

✓ Main Street at Campbell Boulevard
Recommended improvements to achieve acceptable levels of service:
- Near-Term Plus Project scenario:
  - Install Traffic Signal

- Cumulative Year 2042 Plus Project scenario:
  - Install Traffic Signal
  - Widen the westbound approach to 1 left turn lane, 1 through lane, and 1 right turn lane (adding 1 right turn lane)

The improvements identified above for the Near-Term Plus Project, and Cumulative Year 2042 Plus Project scenarios are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'. Improvements were not recommended for the Existing Plus Project scenario since the minor street approach does not generate enough traffic to justify installation of a traffic signal.

✓ Winton Parkway at SR 99 NB Ramps
Recommended improvements to achieve acceptable levels of service:
- Cumulative Year 2042 Plus Project scenario:
  - Install Traffic Signal
  - Widen the southbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)

The improvements identified above for the Cumulative Year 2042 Plus Project scenario are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'.

✓ Winton Parkway at SR 99 SB Ramps
Recommended improvements to achieve acceptable levels of service:
- Existing Plus Project and Near-Term Plus Project scenarios:
  - Install Traffic Signal

- Widen the northbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)
- Widen the eastbound approach to 1 left turn lane and 1 right turn lane (adding 1 left turn lane)

- Cumulative Year 2042 Plus Project scenario:
  - Install Traffic Signal
  - Widen the northbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)
  - Widen the eastbound approach to 1 left turn lane and 2 right turn lane (adding 1 left turn lane and 1 right turn lane)

The improvements identified above for the Existing Plus Project, Near-Term Plus Project, and Cumulative Year 2042 Plus Project scenarios are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'.

✓ <u>Hammatt Avenue at SR 99 NB Ramps</u>
Recommended improvements to achieve acceptable levels of service:

- Existing Plus Project scenario:
  - Install Traffic Signal

- Near-Term Plus Project scenario:
  - Install Traffic Signal
  - Widen the westbound approach to 1 left-through lane and 2 right turn lanes (adding 1 right turn lane)

- Cumulative Year 2042 Plus Project scenario:
  - Install Traffic Signal
  - Widen the southbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)
  - Widen the westbound approach to 1 left-through lane and 2 right turn lanes (adding 1 right turn lane)

The improvements identified above for the Existing Plus Project, Near-Term Plus Project, and Cumulative Year 2042 Plus Project scenarios are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'.

✓ <u>Hammatt Avenue at SR 99 SB Ramps</u>
Recommended improvements to achieve acceptable levels of service:

- Near-Term Plus Project scenario:
  - Install Traffic Signal

- Cumulative Year 2042 Plus Project scenario:

- Install Traffic Signal
- Widen the northbound approach to 1 through lane and 1 right turn lane (adding 1 right turn lane)

The improvements identified above for the Near-Term Plus Project and Cumulative Year 2042 Plus Project scenarios are sufficient to meet the City of Livingston's acceptable LOS standard of 'C'.

Post-Mitigation Level of Service

The level of service resulting from the potential improvements identified above is shown in Table 4-1 for study area intersections. In addition to the proposed improvements identified above, Table 4-2 identifies left turn and right turn pocket lengths required for the Cumulative Year 2042 scenario. The determination of the recommended storage length was determined by the queuing analysis and recommendations of storage lengths found in Chapter 400 of Caltrans' Highway Design Manual. The left turn and right turn pocket length do not include deceleration lengths.

The resulting Cumulative Year 2042 lane geometry at study intersections is shown in Figure 4-1.

Table 4-1
Intersection Operations with Mitigation

INTERSECTION	CONTROL	TARGET LOS	PEAK HOUR	EXISTING PLUS PROJECT		NEAR-TERM PLUS PROJECT		CUMULATIVE YEAR 2042 PLUS PROJECT	
				DELAY	LOS	DELAY	LOS	DELAY	LOS
2. Main Street / Campbell Boulevard	Signalized	C	AM			22.1	C	23.4	C
			PM			17.7	B	19.3	B
3. Winton Parkway / SR 99 NB Ramps	Signalized	C	AM					14.4	B
			PM					32.5	C
4. Winton Parkway / SR 99 SB Ramps	Signalized	C	AM	14.8	B	15.3	B	15.1	B
			PM	23.0	C	26.4	C	23.5	C
5. Hammatt Avenue / SR 99 NB Ramps	Signalized	C	AM	15.8	B	28.3	C	19.5	B
			PM	11.8	B	15.6	B	14.3	B
6. Hammatt Avenue / SR 99 SB Ramps	Signalized	C	AM			22.0	C	19.8	B
			PM			23.4	C	25.3	C

DELAY is measured in seconds
LOS = Level of Service / **BOLD** denotes LOS standard has been exceeded

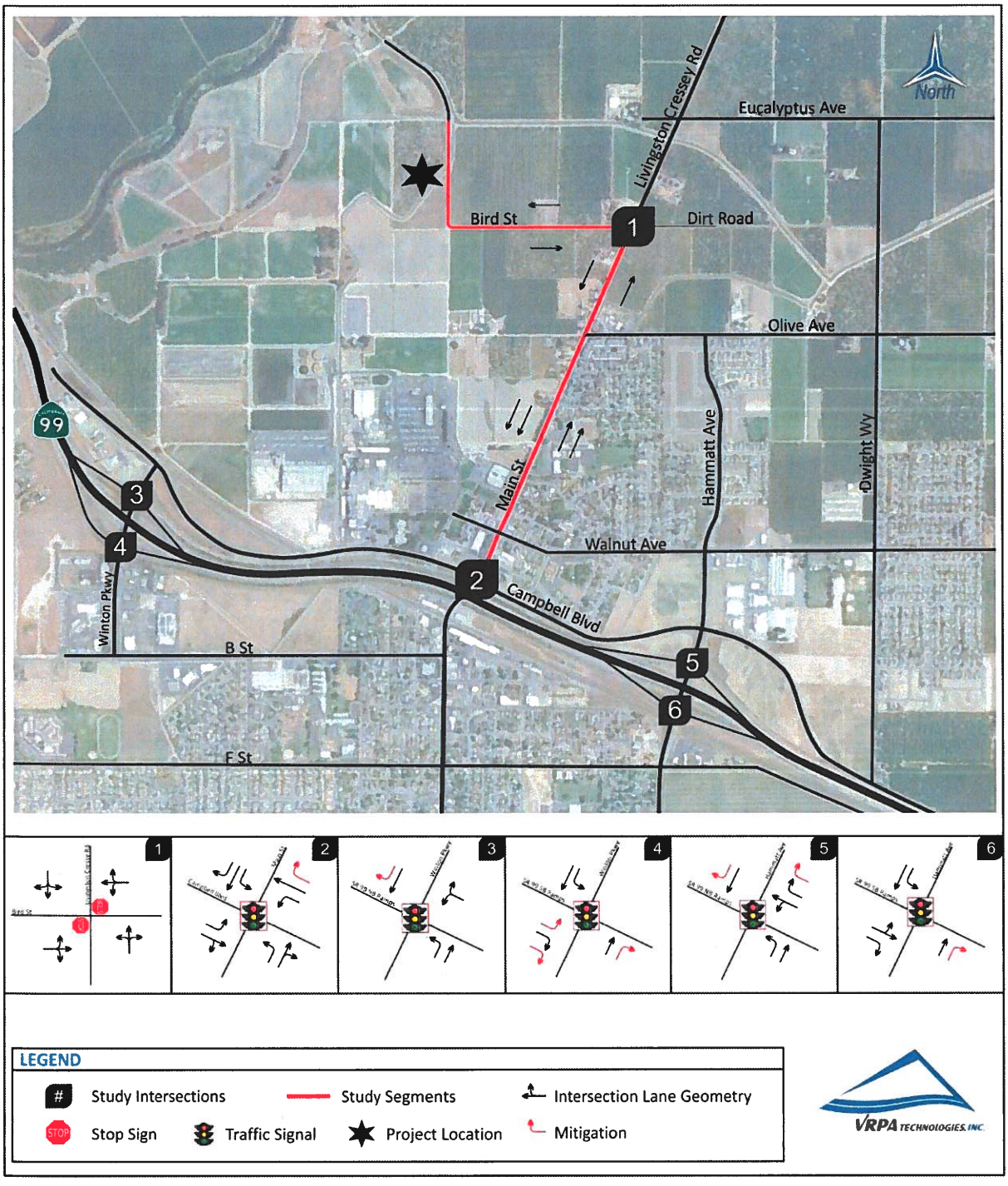
Table 4-2
Left Turn and Right Turn Storage Requirements

INTERSECTION	EXISTING QUEUE STORAGE LENGTH (ft)		CUMULATIVE YEAR 2042 PLUS PROJECT RECOMMENDED QUEUE STORAGE LENGTH (ft)
Main Street / Campbell Boulevard	NB Left	150	150
	SB Left	100	100
	EB Left	200	200
	WB Left	150	150
	WB Right	--	**150**
	WB Right	75	75
Winton Parkway / SR 99 NB Ramps	NB Left	175	175
	SB Right	--	**300**
Winton Parkway / SR 99 SB Ramps	NB Right	--	**300**
	SB Left	200	200
Hammatt Avenue / SR 99 NB Ramps	NB Left	150	150
	SB Right	--	**225**
Hammatt Avenue / SR 99 SB Ramps	NB Right	--	**150**
	SB Left	125	125

BOLD denotes change in storage length

Greenzone Industrial Development
Cumulative Year 2042 Lane Geometry

Figure 4-1



4.2 Equitable Share Responsibility

The proposed Project will be required to contribute a fair share towards the costs of improvements that are identified for the Cumulative Year 2042 scenarios. The intent of determining the equitable responsibility for the improvements identified above for the Cumulative Year 2042 scenarios, is to provide a starting point for early discussions to address traffic mitigation equitability and to calculate the equitable share for mitigating traffic impacts.

The formula used to calculate the equitable share responsibility to the study area is as follows:

Equitable Share = (Project Trips)/(Future Year Plus Approved Project Traffic - Existing Traffic)

Table 4-3 shows the equitable share responsibility to the study area. The equitable share responsibility shown in Table 4-3 is the result of LOS enhancements related to capacity.

Table 4-3
Equitable Share Responsibility

INTERSECTION	PEAK HOUR	EXISTING	PROJECT TRIPS	CUMULATIVE YEAR 2042 PLUS PROJECT	FAIR SHARE PERCENTAGE
Main Street / Campbell Boulevard	AM	1,189	22	1,701	4.3%
	PM	946	28	1,396	6.2%
Winton Parkway / SR 99 NB Ramps	AM	1,284	4	1,727	0.9%
	PM	1,243	6	1,675	1.4%
Winton Parkway / SR 99 SB Ramps	AM	1,711	3	2,301	0.5%
	PM	1,727	2	2,323	0.3%
Hammatt Avenue / SR 99 NB Ramps	AM	1,322	6	2,208	0.7%
	PM	1,262	7	2,131	0.8%
Hammatt Avenue / SR 99 SB Ramps	AM	1,160	1	1,873	0.1%
	PM	1,236	5	2,010	0.6%