

**APPENDIX D:  
TRAFFIC MEMORANDUM**





# Draft Memorandum

Date: December 8, 2020  
To: Aelita Milatzo, City of Sacramento.  
From: Greg Behrens and Emily Alice Gerhart, Fehr & Peers  
Subject: Traffic Study for Maverik Gas Station in Sacramento at Power Inn Road and 14<sup>th</sup> Avenue

*RS20-3975*

This memorandum documents the transportation and site access analysis of the proposed Maverik gas station project at 3855 & 3875 Power Inn Road, located on the north side of 14<sup>th</sup> Avenue east of Power Inn Road in Sacramento, California. The project would include a gas station with 10 fueling positions and a convenience store comprised of 5,951 square feet.

This memorandum is organized into the following sections:

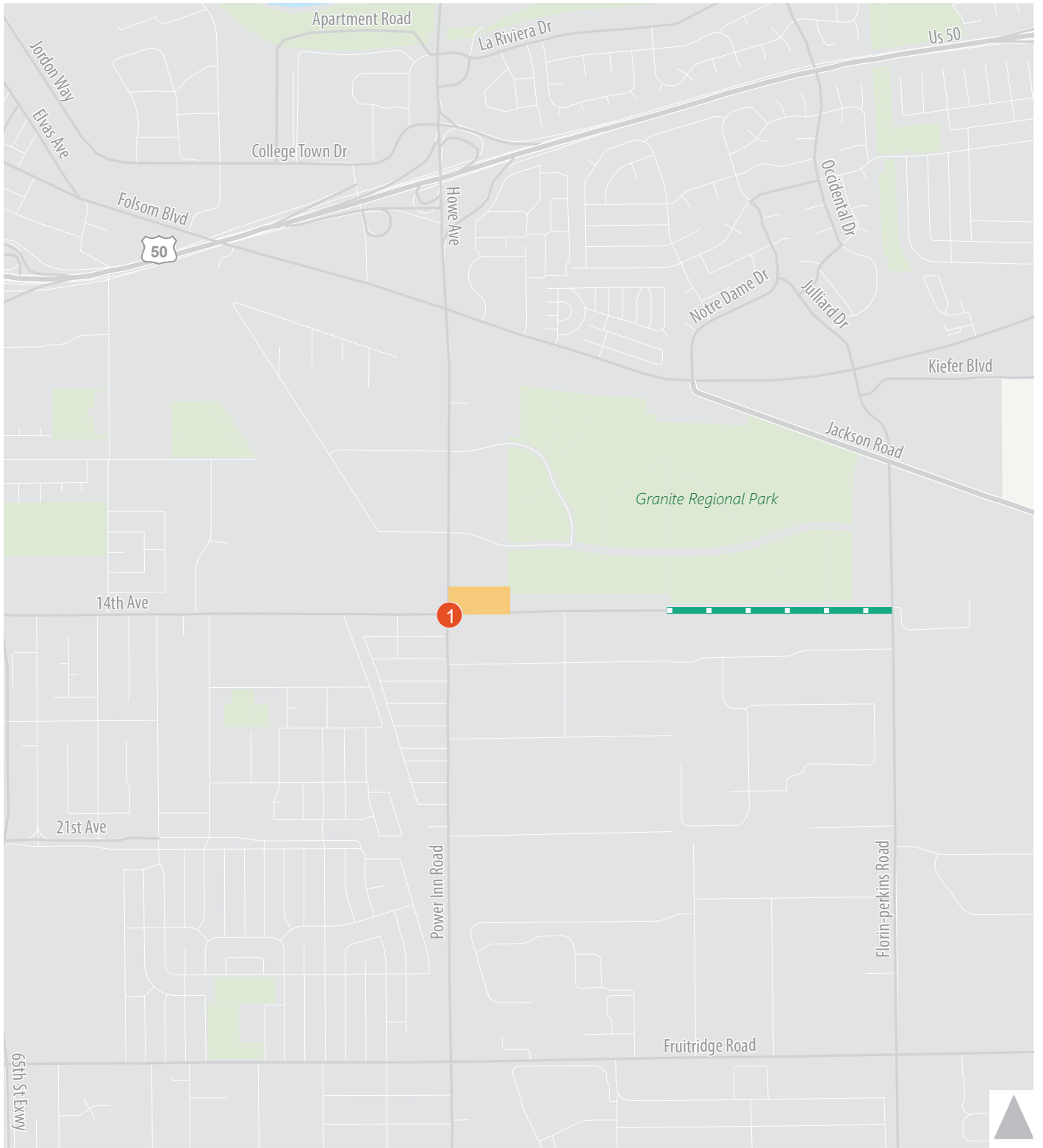
- Baseline Conditions
- Baseline Plus Project Conditions
- Project Access & On-Site Circulation

## Baseline Conditions

### Project Site Setting

Figure 1 shows the project site location. The project site is located on a vacant lot at the northeast corner of the Power Inn Road and 14<sup>th</sup> Avenue intersection. Granite Regional Park (GRP) is located immediately east of the project site.

Along the project site frontage (north of 14<sup>th</sup> Avenue), Power Inn Road is six lanes. South of 14<sup>th</sup> Avenue, Power Inn Road is four lanes plus a two-way left-turn lane (TWLTL). The speed limit is posted at 45 miles per hour and the roadway carries approximately 40,000 vehicles per weekday. To the north, Power Inn Road provides connections to Highway 50 at the Howe Avenue/Power Inn Road interchange, before continuing north as Howe Avenue towards Fair Oaks and Arden-Arcade. To the south, Power Inn Road serves southeast Sacramento, Elk Grove, and parts of unincorporated Sacramento County.



- Study Intersection
- Project Site
- Planned 14th Avenue Extension
- Sacramento City Limits
- Parks and Open Space

Figure 1



## Study Area



West of Power Inn Road, 14<sup>th</sup> Avenue is two lanes plus a TWLTL and has a posted speed limit of 40 miles per hour. East of Power Inn Road, 14<sup>th</sup> Avenue is a minor two-lane roadway that dead-ends approximately one-half mile east of Power Inn Road. The City of Sacramento Capital Improvement Program (CIP) includes a project to extend 14<sup>th</sup> Avenue east to Florin-Perkins Road (CIP Project #T15098600).

Sacramento Regional Transit (SacRT) operates transit service within the project site vicinity. SacRT Gold Line light rail service is available at Power Inn Station approximately one-half mile north of the project site, providing light rail connections east towards Folsom and west towards Downtown Sacramento. SacRT also operates the Granite Park Shuttle, a fixed-route bus service between Power Inn Station and the Granite Regional Park mixed-use complex. The shuttle is fare free and operates Monday through Friday on 15-minute headways throughout the day.

There are sidewalks on both sides of Power Inn Road and on 14<sup>th</sup> Avenue west of Power Inn Road. The Power Inn Road/14<sup>th</sup> Avenue intersection provides marked crosswalks on the east, south, and west legs of the intersection. Sidewalks and bicycle facilities are not currently provided on 14<sup>th</sup> Avenue east of Power Inn Road.

Class II bike lanes are provided in both directions on Power Inn Road and on 14<sup>th</sup> Avenue west of Power Inn Road.

## Methodology

This study analyzes traffic conditions at the study intersection using Level of Service (LOS) as a measure of operational performance. LOS is a qualitative measure of traffic flow from the perspective of motorists and is an indication of the comfort associated with driving. Typical factors that affect LOS include speed, travel time, and traffic interruptions. Empirical LOS criteria and methods of calculation have been documented in the *Highway Capacity Manual, 6<sup>th</sup> Edition* (Transportation Research Board, 2016). LOS is a letter classification system, from A (representing free-flow traffic conditions) to F (oversaturated conditions where traffic demand exceeds capacity, resulting in long queues and delays). These methodologies were implemented using SimTraffic 10 software.

This study analyzes peak hour operations at the following intersection:

1. Power Inn Road/14<sup>th</sup> Avenue

Traffic operations at this intersection was analyzed using SimTraffic 10 simulation software, which accounts for interactions between intersections, queue spillback, vehicle platooning, etc. The program also produces more accurate estimates of vehicular queuing (when compared to more deterministic methods).

### *Applicable LOS Policies*

Per *City of Sacramento 2035 General Plan* Policy M 1.2.2, LOS F is allowed on Howe Avenue (i.e., Power Inn Road south of Folsom Boulevard) from Highway 50 to 14<sup>th</sup> Avenue, which includes the study intersection.



### *Data Collection*

This study analyzes the project's effects on vehicle operations during the weekday AM and PM peak hours. These hours were selected for study because they represent time periods during which the study area would experience high levels of both project-related traffic as well as background traffic.

Intersection turning movement counts were conducted during the AM and PM peak periods on October 15, 2020. Intersection counts included volumes for vehicles, bicyclists, and pedestrians.

The traffic counts were collected during the COVID-19 pandemic, during which typical traffic conditions and operations were affected by stay-at-home orders and related effects of the pandemic. Therefore, in order to estimate typical traffic volumes prior to the COVID-19 pandemic, the following process was employed:

1. Traffic counts were conducted at the study intersection October 2020.
2. October 2020 counts were compared to historic counts, including the following data:
  - a. May 2019 daily roadway counts on Power Inn Road south of 14<sup>th</sup> Avenue
  - b. April 2019 daily roadway counts on 14<sup>th</sup> Avenue west of Power Inn Road
3. Based on this comparison, the October 2020 traffic volumes were increased by approximately 36 percent during the AM peak hour and 18 percent during the PM peak hour such that traffic volumes passing through the intersection are representative of "pre-pandemic" conditions. The data processing preserved 2019 peak hour directional flows and accounted for current travel trends by movement.

Please refer to the technical appendix for additional details regarding this volume adjustment process.

### *14<sup>th</sup> Avenue Extension*

Per direction from City of Sacramento staff, this analysis considers the effects of the proposed project alongside the completion of the 14<sup>th</sup> Avenue extension to Florin-Perkins Road (CIP Project #T15098600). For the purposes of this analysis, the 14<sup>th</sup> Avenue extension would be anticipated to include the following:

- Construction of 14<sup>th</sup> Avenue between Power Inn Road and Florin-Perkins Road as a two-lane arterial with a TWLTL.
- The westbound approach of the Power Inn Road/14<sup>th</sup> Avenue intersection would include a through lane, a left-turn pocket with 160 feet of storage, and a right-turn pocket with 160 feet of storage.
- Continuation of east-west split phase operations at the Power Inn Road/14<sup>th</sup> Avenue intersection.
- Re-timing of the Power Inn Road/14<sup>th</sup> Avenue intersection to accommodate new traffic volumes.

The 14<sup>th</sup> Avenue extension would re-route traffic throughout the study area by providing a new east-west connection and increasing parallel capacity to major routes including Folsom Boulevard, Jackson Road, and Fruitridge Road. Associated changes to traffic patterns were estimated using the SACSIM travel demand model.

The completion of the 14<sup>th</sup> Avenue extension is incorporated in both the Baseline and Baseline Plus Project traffic operations analysis described below.



## Intersection Operations

Table 1 displays the peak hour delay and level of service at the study intersection under Baseline No Project conditions. The study intersection would operate at LOS D during both the AM and PM peak hours under Baseline No Project conditions. Figure 2 displays the peak hour turning movements at the study intersection under Baseline No Project conditions.

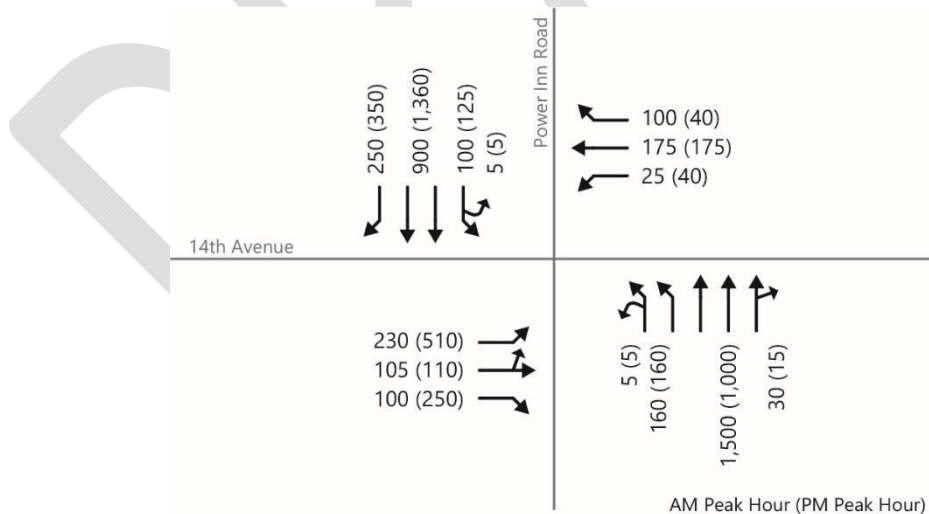
**Table 1: Peak Hour Intersection Operations – Baseline No Project Conditions**

Intersection	Traffic Control <sup>1</sup>	AM Peak Hour		PM Peak Hour	
		Delay <sup>2</sup>	LOS <sup>3</sup>	Delay <sup>2</sup>	LOS <sup>3</sup>
1. Power Inn Road/14 <sup>th</sup> Avenue	Signal	40	D	52	D

Notes:

1. "Signal" represents an intersection that operates with a traffic signal.
2. Delay is reported as seconds per vehicle. Values are rounded to the nearest whole number so the same delay may represent two different LOS conditions if the delay is within 0.5 seconds of the LOS threshold. Average control delay for signalized intersections is the weighted average for all movements.
3. "LOS" represents level of service, calculated based on methodologies contained in the *Highway Capacity Manual, 6<sup>th</sup> Edition* (Transportation Research Board, 2016).

Source: Fehr & Peers, 2020.



**Figure 2. Peak Hour Intersection Turning Movements – Baseline No Project Conditions**



## Vehicle Queues

Table 2 displays the AM and PM peak hour 95<sup>th</sup> percentile queues for the southbound and westbound left-turn movements at the Power Inn Road/14<sup>th</sup> Avenue intersection under Baseline No Project conditions. Under Baseline No Project conditions, sufficient storage would be available to accommodate the southbound left-turn 95<sup>th</sup> percentile queues during both the AM and PM peak hours. However, the westbound left-turn 95<sup>th</sup> percentile queue would exceed the available storage during the PM peak hour.

Fehr & Peers recommends that the westbound left-turn lane be constructed with 200 feet of storage to accommodate the PM peak hour 95<sup>th</sup> percentile queue under Baseline No Project conditions.

**Table 2: Peak Hour 95<sup>th</sup> Percentile Queues – Baseline No Project Conditions**

Movement	Direction	Movement	Storage (ft.)	95 <sup>th</sup> Percentile Vehicle Queue <sup>1</sup> (vehicles)	
Power Inn Road	AM Peak Hour	SB	Left	285 ft.	200 ft. (8 vehicles)
	PM Peak Hour	SB	Left	285 ft.	250 ft. (10 vehicles)
14 <sup>th</sup> Avenue	AM Peak Hour	WB	Left	160 ft.	150 ft. (6 vehicles)
	PM Peak Hour	WB	Left	160 ft.	<b>175 ft. (7 vehicles)</b>

Notes:

**Grey** text indicates that the 95<sup>th</sup> percentile queue exceeds the available storage capacity.

1. 95<sup>th</sup> percentile queue lengths estimated using SimTraffic traffic operations analysis software. Queue lengths rounded up to the nearest 25-foot increment.

Source: Fehr & Peers, 2020.





## Baseline Plus Project Conditions

Figure 3 shows the project site plan (*Preliminary Site Plan*, Cartwright Nor Cal, November 9, 2020). The proposed project would include a 5,951 square foot convenience store and 10 fueling positions. The proposed project would also include 10 restrooms open to the public. The project site would provide a stop for the existing Granite Park Shuttle.

The project would be accessed via an existing full access driveway on 14<sup>th</sup> Avenue located 525 feet east of Power Inn Road, as well as a new right-in/right-out only (RIRO) driveway on Power Inn Road located 250 north of 14<sup>th</sup> Avenue. According to the project site plan, the project would construct a new marked crosswalk on the north leg of the Power Inn Road/14<sup>th</sup> Avenue intersection. Note that this modification would require new traffic signal equipment (e.g., pedestrian signal heads) and signal re-timing in order to accommodate a new pedestrian crossing phase on the north leg crossing. The project would also include the construction of new sidewalk on its 14<sup>th</sup> Avenue frontage.

The project would include modifications to 14<sup>th</sup> Avenue east of Power Inn Road. The extents of the modifications would begin at Power Inn Road and end approximately 360 feet east of Power Inn Road. In the westbound direction, the modifications would include two through lanes, a left-turn lane with 160 feet of storage, and a right-turn lane with 160 feet of storage. Additionally, the modifications would include two eastbound travel lanes. The roadway would taper down to a two-lane cross-section immediately west of the project driveway on 14<sup>th</sup> Avenue.

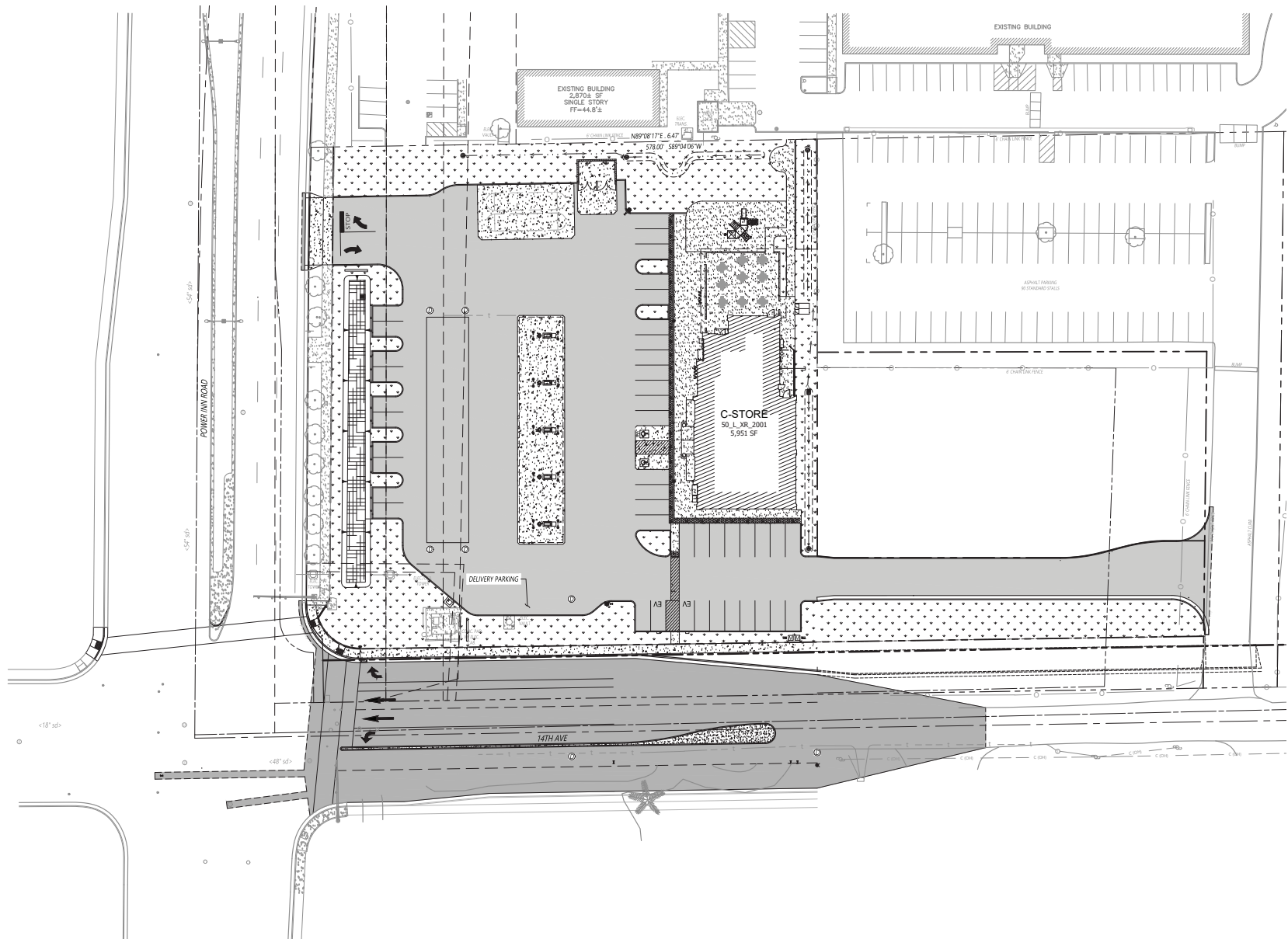
## Travel Characteristics

### *Trip Generation*

Typically, the trip generation of a proposed project is calculated using trip rates or equations contained in the *Institute of Transportation Engineers (ITE) Trip Generation Manual*. However, Fehr & Peers' experience analyzing comparable Maverik stores indicates that ITE rates substantially overstate peak hour trip generation compared to empirical data reviewed at existing Maverik stores.

In order to estimate trip generation for the proposed project, sales transaction data was obtained from four existing and comparable Maverik stores. Store #540 in Thornton, CO is similar to the Power Inn Maverik store in that both would have 10 fueling positions. Stores #420 (West Valley, UT), #423 (Salt Lake City, UT), and #473 (Spokane Valley, WA) have 20 fueling positions, but have surrounding travel patterns that would be analogous to the Power Inn Maverik according to Maverik representatives. Maverik provided store transaction data for all Mondays, Tuesdays, Wednesdays, and Thursdays in October 2019, which is an above average month in terms of fuel sales. Fehr & Peers conducted a weighted average of these four stores to estimate transactions for the proposed project.

These data were supplemented by collecting local "internal trip estimates" at one of the Maverik sites in Salt Lake City, and at the combined McDonalds/Chevron on Blue Oaks Boulevard in Roseville. It was necessary to determine the proportion of fuel sales that also included a purchase inside store using sales transaction data due to the inclusion of the convenience store in the project description.



Source: Preliminary Site Plan, Cartwright Nor Cal, November 9, 2020

Figure 3





Table 3 shows the proposed project trip generation, including reductions for pass-by trips. Pass-by trips are trips already on the network and therefore would not be considered as new trips generated by the project. Pass-by trips were estimated from data presented in the *Trip Generation Handbook, 3<sup>rd</sup> Edition* (Institute of Transportation Engineers, 2017). Technical calculations are available in the technical appendix.

As shown in Table 3, during the AM peak hour, the project would generate 70 net new vehicle trips (50 percent in/50 percent out). During the PM peak hour, the project would generate 64 net new vehicle trips (50 percent in/50 percent out). Daily, the project would generate 1,044 net new vehicle trips. These represent net new external vehicle trips after accounting for reductions made for pass-by activity per the Trip Generation Handbook (ITE, 2017).

**Table 3: Project Trip Generation**

	Daily	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Total Gross Trips	4,246	142	142	284	130	130	260
Pass-By Trip Reduction (76%)	-3,202	-107	-107	-214	-98	-98	-196
<b>Net New External Trips</b>	<b>1,044</b>	<b>35</b>	<b>35</b>	<b>70</b>	<b>32</b>	<b>32</b>	<b>64</b>

Note:

Trip generation estimate calculated using observed data and pass-by rates obtained from *Trip Generation Handbook, 3<sup>rd</sup> Edition* (Institute of Transportation Engineers, 2017) for the Gas Station land use (Land Use Code 945).  
 Source: Fehr & Peers, Maverik, and *Trip Generation Handbook, 3<sup>rd</sup> Edition*, 2020.

### *Trip Distribution and Trip Assignment*

New project trips were assigned to the roadway network based on existing traffic patterns and the general distribution of jobs, housing, and other destinations in the area, as well as permitted driveway movements. The net new external trips were assigned to the roadway network as follows:

<u>Direction</u>	<u>AM Percentage</u>	<u>PM Percentage</u>
Power Inn Road to/from the south	48%	30%
Power Inn Road to/from the north	33%	43%
14 <sup>th</sup> Avenue to/from the west	10%	19%
14 <sup>th</sup> Avenue to/from the east	9%	8%

Pass-by trips were assigned based on the volume of traffic on Power Inn Road and 14<sup>th</sup> Avenue and ease of performing pass-by maneuvers.



## Intersection Operations

The project would increase peak hour traffic volumes and vehicle delay on roadways within the immediate vicinity of the project site. Figure 4 displays the peak hour turning movements at the study intersection under Baseline Plus Project conditions.

Table 4 presents the average delay and LOS under Baseline Plus Project conditions at the study intersection. The intersection would operate at LOS E during both the AM and PM peak hours under Baseline Plus Project conditions.

**Table 4: Peak Hour Intersection Operations – Baseline Plus Project Conditions**

Intersection	Traffic Control <sup>1</sup>	AM Peak Hour		PM Peak Hour	
		Delay <sup>2</sup>	LOS <sup>3</sup>	Delay <sup>2</sup>	LOS <sup>3</sup>
1. Power Inn Road/14th Avenue	Signal	74	E	66	E

Notes:

1. "Signal" represents an intersection that operates with a traffic signal.
2. Delay is reported as seconds per vehicle. Values are rounded to the nearest whole number so the same delay may represent two different LOS conditions if the delay is within 0.5 seconds of the LOS threshold. Average control delay for signalized intersections is the weighted average for all movements.
3. "LOS" represents level of service, calculated based on methodologies contained in the *Highway Capacity Manual, 6<sup>th</sup> Edition* (Transportation Research Board, 2016).

Source: Fehr & Peers, 2020.

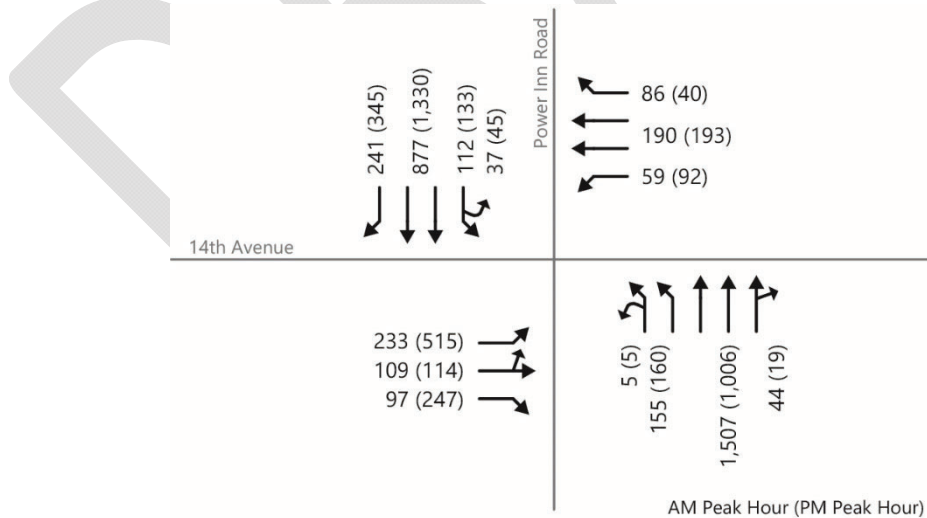


Figure 4. Peak Hour Intersection Turning Movements – Baseline Plus Project Conditions



## Vehicle Queues

Table 5 displays the AM and PM peak hour 95<sup>th</sup> percentile queues for the southbound and westbound left-turn movements at the Power Inn Road/14<sup>th</sup> Avenue intersection under Baseline Plus Project conditions. Under Baseline Plus Project conditions, sufficient storage would be available to accommodate the southbound left-turn 95<sup>th</sup> percentile queues during both the AM and PM peak hours. However, the westbound left-turn 95<sup>th</sup> percentile queue would exceed the available storage during the PM peak hour.

**Table 5: Peak Hour 95<sup>th</sup> Percentile Queues – Baseline Plus Project Conditions**

Movement	Direction	Movement	Storage (ft.)	95 <sup>th</sup> Percentile Vehicle Queue <sup>1</sup> (vehicles)
Power Inn Road	AM Peak Hour	SB	Left	285 ft. 250 ft. (10 vehicles)
	PM Peak Hour	SB	Left	285 ft. 250 ft. (10 vehicles)
14 <sup>th</sup> Avenue	AM Peak Hour	WB	Left	160 ft. 125 ft. (5 vehicles)
	PM Peak Hour	WB	Left	160 ft. <b>175 ft. (7 vehicles)</b>
Power Inn Road Driveway	AM Peak Hour	WB	Right	75 ft. 75 ft. (3 vehicles)
	PM Peak Hour	WB	Right	75 ft. 50 ft. (2 vehicles)
14 <sup>th</sup> Avenue Driveway	AM Peak Hour	SB	Left/Right	60 ft. 50 ft. (2 vehicles)
	PM Peak Hour	SB	Left/Right	60 ft. <b>75 ft. (3 vehicles)</b>
	AM Peak Hour	EB	Left <sup>2</sup>	0 ft. <b>50 ft. (2 vehicles)</b>
	PM Peak Hour	EB	Left <sup>2</sup>	0 ft. <b>75 ft. (3 vehicles)</b>

Notes:

Grey text indicates that the 95<sup>th</sup> percentile queue exceeds the available storage capacity.

1. 95<sup>th</sup> percentile queue lengths estimated using SimTraffic traffic operations analysis software. Queue lengths rounded up to the nearest 25-foot increment.
2. Eastbound 14<sup>th</sup> Avenue would not include a left-turn lane along the project frontage. Thus, these movements would be completed from the eastbound through lane.

Source: Fehr & Peers, 2020.



Fehr & Peers recommends that the westbound left-turn lane be constructed with 200 feet of storage to accommodate the PM peak hour 95<sup>th</sup> percentile queue under Baseline No Project conditions.

Fehr & Peers also recommends modifying the traffic signal at the Power Inn Road/14<sup>th</sup> Avenue intersection to operate with protected left-turn phases in the eastbound and westbound directions (versus the existing east-west split phases). While not required in order to address project-related effects on peak hour traffic operations, this modification would enable the signal to operate more efficiently compared to its current timing and phasing plan. The modification would require that the eastbound approach be reconfigured to dual left-turn lanes and a shared through-right lane. The eastbound shared through-right lane would be aligned with the eastbound lane on the east leg of the Power Inn Road/14<sup>th</sup> Avenue intersection that is proposed as part of the Maverik project. With this signal modification, the intersection could be operated to allow for overlapping eastbound and westbound left-turn phases. A truck turning analysis (refer to the technical appendix) indicates that simultaneous eastbound and westbound left-turning trucks would clear each other, however, drivers would be required to execute these maneuvers with little room for error. The following modifications are recommended in order to better accommodate simultaneous eastbound and westbound left-turning vehicle maneuvers:

- Relocate the east leg median nose 15 feet east of the location shown on the project site plan and reposition the westbound left-turn lane stop bar.
- Relocate the south leg median nose and left-most northbound left-turn lane stop bar 20 feet south of their current locations.
- Install skip stripe guidance markings (i.e., “cat tracking”) for both sides of the westbound left-turn path of travel and for the outside of the path travel for the right-most eastbound left-turn lane.

The intersection could also be operated to separate the eastbound and westbound left-turn phases (through separate lead/lag phasing) if physical modifications to the intersection are not desirable.



## Project Access and On-Site Circulation

This section outlines the access and on-site circulation components of the project.

### 14<sup>th</sup> Avenue Driveway

The 14<sup>th</sup> Avenue project driveway is an existing driveway that currently serves surface parking lots surrounding the Sacramento County office buildings located northeast of the project site. The driveway is approximately 25 feet wide. The project would not include any changes to the driveway itself. However, the project would construct a new east-west drive aisle between the driveway and the Maverik site. The resulting driveway throat depth would be approximately 60 feet between the northerly edge of pavement on 14<sup>th</sup> Avenue and the east-west drive aisle.

#### *Outbound Maneuvers*

Outbound maneuvers from the 14<sup>th</sup> Avenue driveway would occur from a southbound shared left-right lane. As shown in Table 5, the outbound 95<sup>th</sup> percentile queue at the 14<sup>th</sup> Avenue driveway would be sufficiently accommodated within the 60 feet of available storage during the AM peak hour. However, the outbound 95<sup>th</sup> percentile queue would extend to a length of 75 feet during the PM peak hour, which would cause occasional blocking of the east-west drive aisle. In instances where the blocked drive aisle would be caused by southbound through vehicles (i.e., those traveling from the Sacramento County office buildings parking lots), the outbound queue would block access into the project site for inbound vehicles traveling from 14<sup>th</sup> Avenue. This condition could result in inbound queue spillbacks onto 14<sup>th</sup> Avenue.

Fehr & Peers recommends that the 14<sup>th</sup> Avenue driveway and new east-west drive aisle be modified to reduce the potential for outbound queues to block inbound vehicle traffic traveling to the project site from 14<sup>th</sup> Avenue. Potential modifications include, but are not limited to, the following:

- Relocate the Maverik east-west drive aisle further to the north to provide a throat depth of at least 75 feet for the 14<sup>th</sup> Avenue driveway.
- Install “keep clear” markings at the intersection of the Maverik east-west drive aisle and the 14<sup>th</sup> Avenue driveway. Install stop signs at the eastbound and southbound approaches of this internal intersection.

The selection of a preferred option should consider existing access needs for the Sacramento County office buildings as well as future access needs for the vacant parcels located immediately east of the project site. The selection of a preferred option should additionally consider the future placement of the northerly curb of 14<sup>th</sup> Avenue associated with the 14<sup>th</sup> Avenue extension project (i.e., to maintain at least 75 feet of driveway throat depth).



### *Inbound Maneuvers*

Eastbound left-turns into the site would be completed from the eastbound through lane. Therefore, vehicles in the eastbound left-turn queue would block eastbound through traffic while waiting for a gap in opposing traffic. This condition could increase the potential for rear-end conflicts at this location.

Fehr & Peers recommends that a TWLTL be constructed on 14<sup>th</sup> Avenue beginning at the end of the westbound left-turn pocket at the Power Inn Road/14<sup>th</sup> Avenue intersection and ending approximately 100 feet east of the project's 14<sup>th</sup> Avenue driveway. This modification should adhere to applicable City arterial design standard and be integrated into the 14<sup>th</sup> Avenue extension project. The TWLTL would accommodate left-turns in and out of the project's 14<sup>th</sup> Avenue driveway while minimizing their effects on through traffic along 14<sup>th</sup> Avenue.

### **Power Inn Road Driveway**

The new Power Inn Road project driveway would provide right-in/right-out only access to and from the project site. The driveway would be approximately 40 feet wide and provide a throat depth of approximately 40 feet. Based on the configuration of the driveway and its placement relative to on-site facilities, the driveway would provide approximately 75 feet of storage for outbound vehicle queues.

### *Outbound Maneuvers*

As shown in Table 5, the outbound 95<sup>th</sup> percentile queue at the Power Inn Road driveway would be sufficiently accommodated within the 75 feet of available storage.

### *Inbound Maneuvers*

Northbound right-turns into the site would be completed from the outside northbound through lane. The project would generate considerable peak hour right-turn volumes at this driveway, including nearly 100 vehicles during the AM peak hour. Power Inn Road has a posted speed limit of 45 miles per hour along the project site frontage. Vehicles completing a northbound right-turn movement into the project site driveway would be required to slow to speeds in the 10 to 15 mile per hour range while maneuvering into the project site. Therefore, a considerable speed differential (equal to or greater than 30 miles per hour) would exist between northbound through traffic and northbound right-turning traffic, which could in turn increase the potential for rear-end conflicts at this location.

Fehr & Peers recommends the construction of a northbound right-turn pocket/deceleration lane at the project's Power Inn Road driveway. Note that this modification would require widening of Power Inn Road as well as a reconfiguration of the western portion of the project site plan. This modification should include high visibility conflict markings for the northbound bike lane that would be located between the through lane and the right-turn lane.





## Fuel Truck Turning Analysis

Figure 5 illustrates an AutoTURN analysis prepared by the project applicant illustrating fuel truck circulation through the project site (*Fueling Truck Ingress/Egress Exhibit*, Cartwright Nor Cal, November 9, 2020). This analysis utilizes a WB-67 truck as the design vehicle, which measures approximately 70 feet in length from the front of the tractor to the back of the trailer.

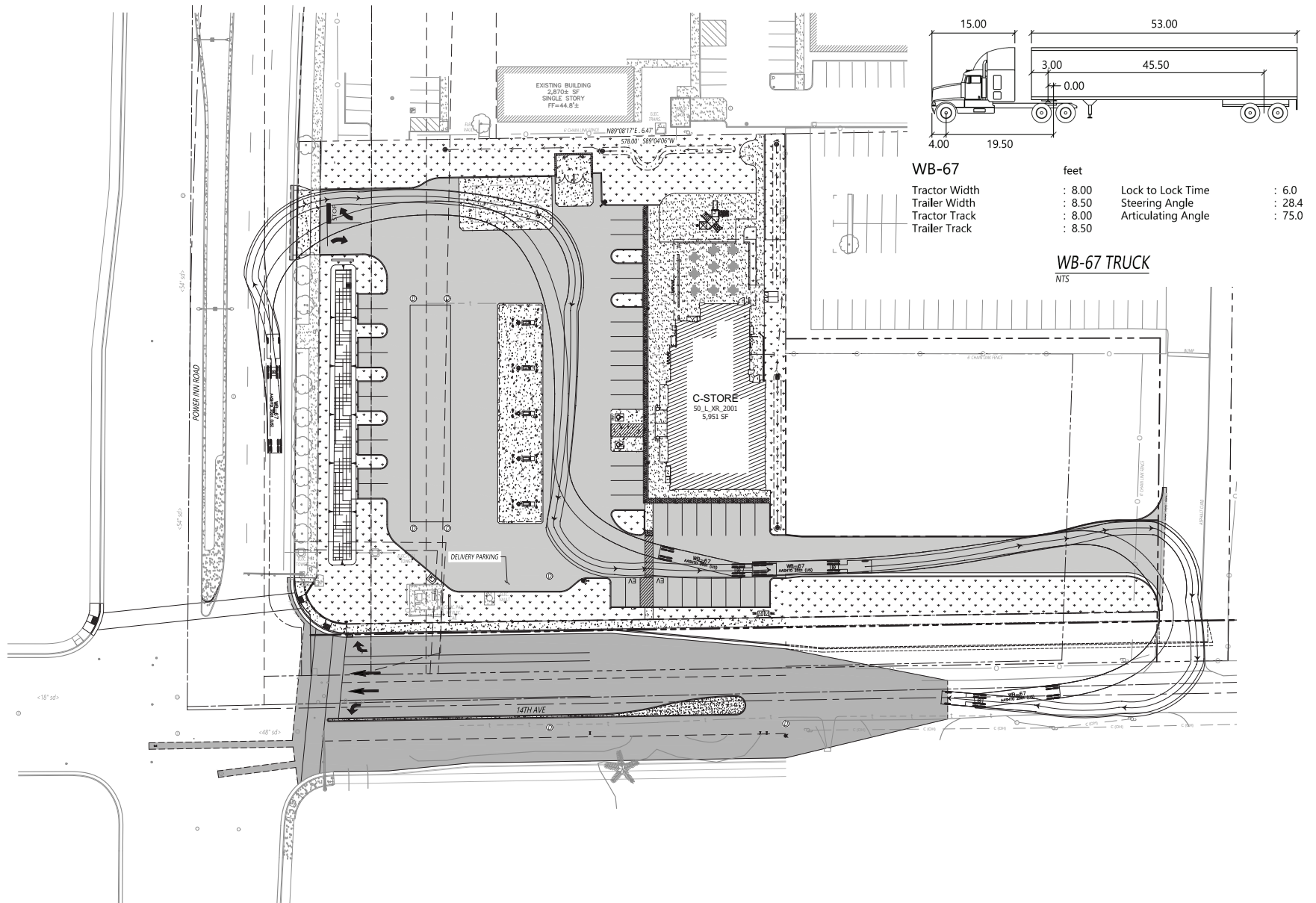
Fuel trucks would enter the site via the Power Inn Road driveway and exit via the 14<sup>th</sup> Avenue driveway (in a clockwise pattern). According to the AutoTURN analysis, fuel trucks entering the site would be required to swing across all three lanes of traffic on Power Inn Road in order to maneuver into the Power Inn Road driveway. Upon entering the site, fuel trucks would be required to travel contraflow in the outbound travel lane at the Power Inn Road driveway in order to complete this maneuver. This would require fuel trucks to wait on Power Inn Road for the outbound lane to be clear of queued vehicles. Altogether, these conditions could cause adverse operational effects and increase the potential for conflicts with westbound traffic exiting the project site via the Power Inn Road driveway and with adjacent traffic on northbound Power Inn Road.

Fuel trucks exiting the site would travel eastbound using the new east-west Maverik drive aisle before turning south and then west onto 14<sup>th</sup> Avenue via the existing 14<sup>th</sup> Avenue driveway. The AutoTURN analysis indicates that the fuel truck trailer swept path would travel outside of the paved area on the 14<sup>th</sup> Avenue driveway. Additionally, the analysis indicates that the fuel truck tractor would be required to travel contraflow in the inbound travel lane at the 14<sup>th</sup> Avenue driveway and in the eastbound travel lane on 14<sup>th</sup> Avenue to complete this maneuver. Altogether, these conditions could cause adverse operational effects and increase the potential for conflicts with northbound traffic using the 14<sup>th</sup> Avenue driveway and with adjacent traffic on eastbound and westbound 14<sup>th</sup> Avenue.

Fehr & Peers recommends that the Power Inn Road and 14<sup>th</sup> Avenue project driveways be constructed to City standard and to better accommodate fuel truck movements and swept paths. Specifically, the driveways should be constructed in a manner that reduces the potential for conflicts between truck movements and adjacent vehicle traffic, particularly:

- At the Power Inn Road driveway, a) conflicts between northbound right-turning trucks and northbound through traffic on Power Inn Road and b) conflicts between northbound right-turning trucks and westbound vehicle traffic exiting the project site.
- At the 14<sup>th</sup> Avenue driveway, conflicts between eastbound right-turning trucks and westbound traffic entering the east-west Maverik drive aisle and northbound traffic entering the 14<sup>th</sup> Avenue driveway.
- At the 14<sup>th</sup> Avenue driveway, conflicts between southbound right-turning trucks and eastbound through traffic on 14<sup>th</sup> Avenue.

Additionally, Fehr & Peers recommends that the 14<sup>th</sup> Avenue driveway be widened to a width of 30 feet or more between the Maverik east-west drive aisle and 14<sup>th</sup> Avenue to better accommodate fuel truck movements and swept paths.



Source: Fueling Truck Ingress/Egress Exhibit, Cartwright Nor Cal, November 9, 2020

Figure 5





## Summary & Conclusions

In summary, based on a review of the project, Fehr & Peers recommends the following modifications to the surrounding roadway network:

- Construct the westbound left-turn lane of the Power Inn Road/14<sup>th</sup> Avenue intersection with 200 feet of storage.
- Modify the traffic signal at the Power Inn Road/14<sup>th</sup> Avenue intersection to operate with protected left-turn phases in the eastbound and westbound directions.
- Install new pedestrian signal heads and re-time the Power Inn Road/14<sup>th</sup> Avenue intersection traffic signal to accommodate a new pedestrian crossing phase for the north leg of the intersection (these modifications would be required due to the new north leg pedestrian crossing that is proposed as part of the project).
- Modify the 14<sup>th</sup> Avenue driveway and the new east-west drive aisle to reduce the potential for outbound queues to block inbound vehicle traffic traveling to the project site from 14<sup>th</sup> Avenue.
- Construct a TWLTL on 14<sup>th</sup> Avenue beginning at the end of the westbound left-turn pocket at the Power Inn Road/14<sup>th</sup> Avenue intersection and ending approximately 100 feet east of the project's 14<sup>th</sup> Avenue driveway.
- Construct a northbound right-turn pocket/deceleration lane at the project's Power Inn Road driveway.
- Construct the Power Inn Road and 14<sup>th</sup> Avenue project driveways to City standard in order to better accommodate fuel truck movements and swept paths and to reduce the potential for conflicts between trucks and adjacent vehicle traffic.

Figure 6 provides a summary of these recommendations.

The City should consider the near-term operational needs associated with the 14<sup>th</sup> Avenue extension with respect to its components that are constructed alongside the Maverik project in the near-term. For example, the project site plan proposes two through lanes on 14<sup>th</sup> Avenue in both the eastbound and westbound directions east of Power Inn Road, while the City has recently indicated that the 14<sup>th</sup> Avenue extension would be constructed as a two-lane arterial. The City may determine that while it is beneficial to dedicate the right-of-way necessary to accommodate these additional travel lanes, the additional lane capacity is not necessary to maintain desirable near-term operations. In this case, the City could pave only what is needed in the near-term, while allocating excess right-of-way to other uses such as landscaping or in-street bicycle facilities until the capacity is needed at a later date (e.g., the landscaped area reserved for a future right-turn lane on eastbound Folsom Boulevard at 65<sup>th</sup> Street).

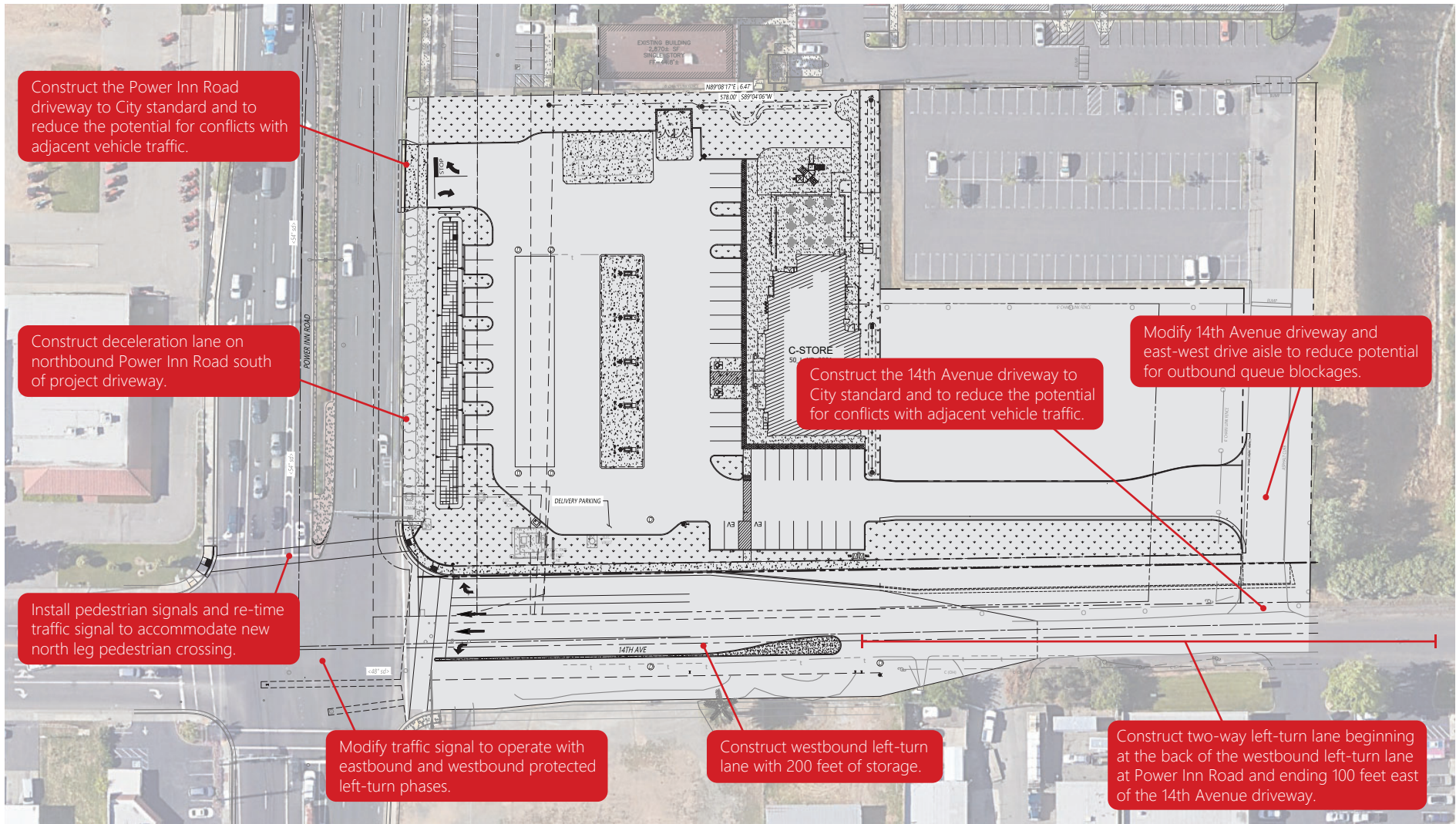


Figure 6





## References

Institute of Transportation Engineers (2017). *Trip Generation Handbook, 3<sup>d</sup> Edition*.

Institute of Transportation Engineers (2017). *Trip Generation Manual, 10<sup>th</sup> Edition*.

Transportation Research Board (2016). *Highway Capacity Manual, 6<sup>th</sup> Edition*.

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## Technical Appendix

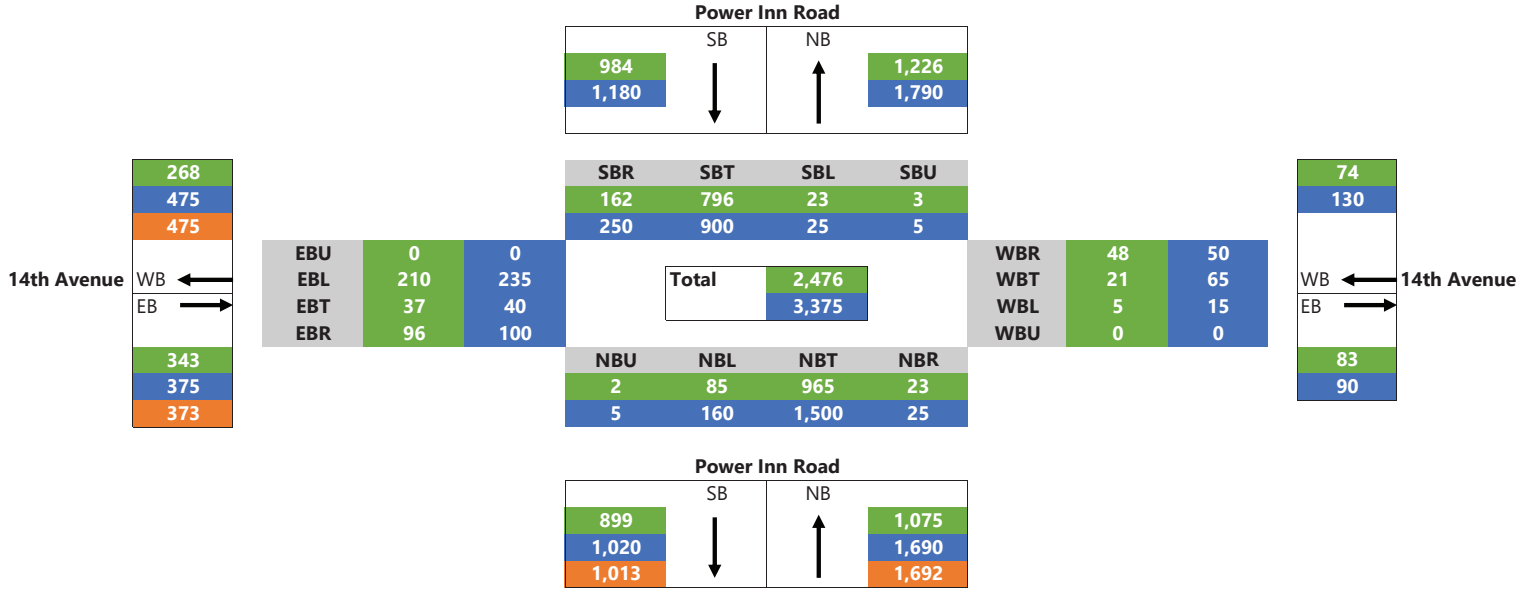
- A. Traffic Volume Calculations
- B. Project Trip Generation Calculations
- C. Traffic Operations Analysis Results
- D. Power Inn Road/14<sup>th</sup> Avenue Truck Turn Analysis

DRAFT

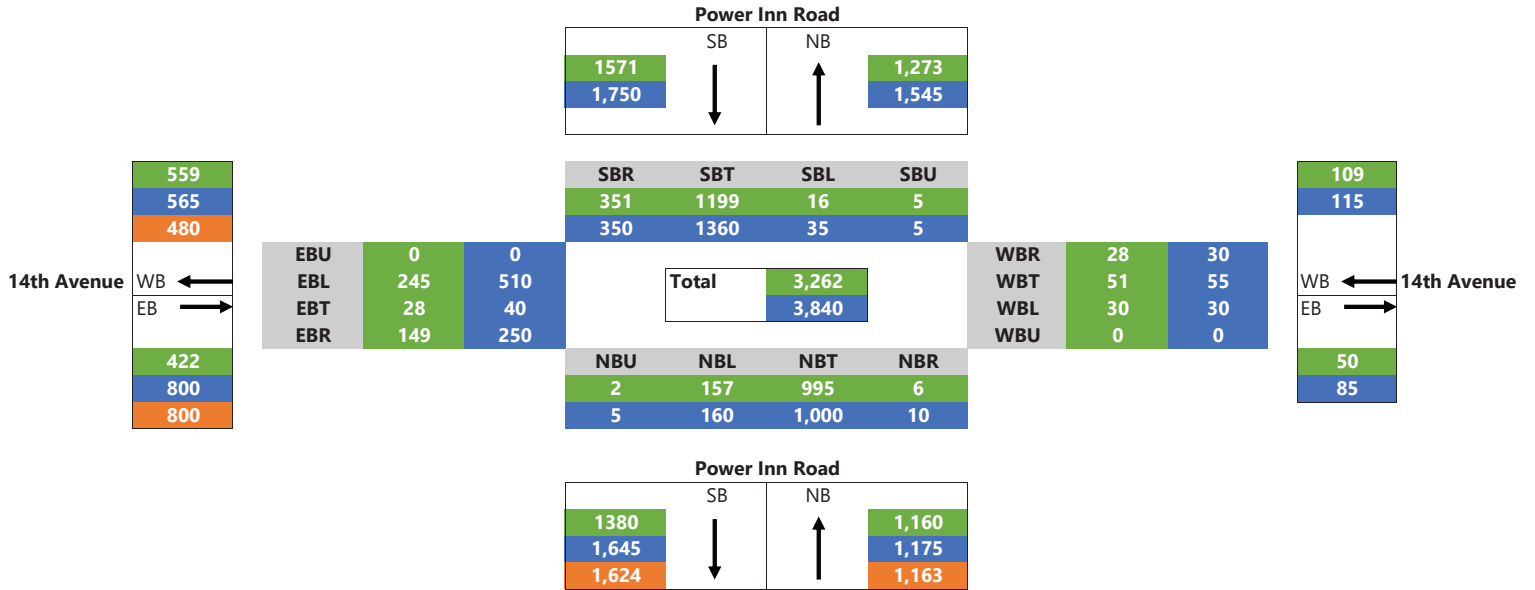
**Power Inn Road/14th Avenue Intersection Turning Movement Volume Calculations**

- Green Weekday peak hour intersection turning movement data collected on October 15, 2020
- Orange Weekday daily and hourly roadway segment data collected in Spring 2019
- Blue Adjusted peak hour intersection turning movement estimates (i.e., pre-pandemic "existing" traffic volumes)

**AM Peak Hour (7:30 AM)**



**PM Peak Hour (4:30 PM)**



Average Weekday Transaction Counts Maverik #540 10 fueling positions (same as Power Inn Maverik)			Average Weekday Transaction Counts Maverik #420,#423,#473 20 fueling positions, but traffic patterns similar to Power Inn Maverik			Average Weekday Transaction Counts Maverik #420,#423,#473,#540 Weighted average			Transaction Internalization	Net In Store Transactions In Store-Only Transactions Minus Fuel-Only Transactions	Total Transactions In Store-Only Transactions Plus Fuel-Only Transactions	Gross Trips				Pass-By Trip Reduction Pass-by trip rate of 76% identified for the Gas Station (945) land use category in the ITE <i>Trip Generation Handbook</i> . 76% 76%				New External Vehicle Trips Represents new vehicle trips that the project would generate on the surrounding roadway network.					
Hour	Average Fuel Transactions	Average In Store	Hour	Average Fuel Transactions	Average In Store	Hour	Average Fuel Transactions	Average In Store	% Who Fuel and Then Make Store Transaction	Hour	Average Transactions	Hour	Average Transactions	Hour	In	Out	Total	Hour	In	Out	Total	Hour	In	Out	Total
0	6.4	13.0	0	7.7	19.5	0	7.4	17.9	5%	0	17.5	0	24.9	0	25	25	50	0	-18	-18	-36	0	7	7	14
1	3.8	7.6	1	5.9	13.1	1	5.4	11.7	5%	1	11.5	1	16.8	1	17	17	34	1	-12	-12	-24	1	5	5	10
2	3.4	6.8	2	4.2	12.0	2	4.0	10.7	5%	2	10.5	2	14.5	2	15	15	30	2	-11	-11	-22	2	4	4	8
3	3.5	6.6	3	5.7	13.5	3	5.2	11.8	5%	3	11.5	3	16.7	3	17	17	34	3	-12	-12	-24	3	5	5	10
4	5.8	13.2	4	9.5	24.7	4	8.6	21.8	5%	4	21.4	4	30.0	4	30	30	60	4	-22	-22	-44	4	8	8	16
5	19.4	40.5	5	17.7	54.7	5	18.1	51.2	5%	5	50.2	5	68.4	5	69	69	138	5	-52	-52	-104	5	17	17	34
6	37.2	71.6	6	31.6	92.8	6	33.0	87.5	15%	6	82.6	6	115.6	6	116	116	232	6	-88	-88	-176	6	28	28	56
7	46.6	88.9	7	44.3	110.0	7	44.9	104.7	20%	7	95.8	7	140.6	7	141	141	282	7	-107	-107	-214	7	34	34	68
8	40.8	69.5	8	51.3	113.0	8	48.7	102.1	20%	8	92.4	8	141.1	8	142	142	284	8	-107	-107	-214	8	35	35	70
9	28.9	51.9	9	48.0	93.1	9	43.2	82.8	10%	9	78.5	9	121.7	9	122	122	244	9	-92	-92	-184	9	30	30	60
10	27.6	42.0	10	44.2	78.5	10	40.1	69.4	10%	10	65.4	10	105.4	10	106	106	212	10	-80	-80	-160	10	26	26	52
11	30.0	45.0	11	47.2	82.0	11	42.9	72.8	15%	11	66.3	11	109.2	11	110	110	220	11	-83	-83	-166	11	27	27	54
12	33.5	51.4	12	52.5	97.2	12	47.8	85.8	20%	12	76.2	12	124.0	12	124	124	248	12	-94	-94	-188	12	30	30	60
13	35.7	53.4	13	50.2	80.5	13	46.6	73.7	20%	13	64.4	13	111.0	13	111	111	222	13	-84	-84	-168	13	27	27	54
14	36.6	51.7	14	52.9	79.5	14	48.8	72.6	10%	14	67.7	14	116.5	14	117	117	234	14	-88	-88	-176	14	29	29	58
15	46.8	67.1	15	62.2	83.5	15	58.4	79.4	10%	15	73.6	15	131.9	15	132	132	264	15	-100	-100	-200	15	32	32	64
16	56.6	72.4	16	65.5	85.6	16	63.3	82.3	25%	16	66.5	16	129.8	16	130	130	260	16	-98	-98	-196	16	32	32	64
17	59.5	72.6	17	66.1	82.5	17	64.5	80.0	25%	17	63.9	17	128.4	17	129	129	258	17	-98	-98	-196	17	31	31	62
18	56.8	67.0	18	56.5	73.3	18	56.6	71.7	10%	18	66.1	18	122.6	18	123	123	246	18	-93	-93	-186	18	30	30	60
19	42.9	56.7	19	44.6	62.3	19	44.2	60.9	10%	19	56.5	19	100.7	19	101	101	202	19	-76	-76	-152	19	25	25	50
20	33.5	50.6	20	35.4	54.2	20	34.9	53.3	5%	20	51.6	20	86.5	20	87	87	174	20	-66	-66	-132	20	21	21	42
21	23.8	36.4	21	26.0	42.9	21	25.5	41.3	5%	21	40.0	21	65.5	21	66	66	132	21	-50	-50	-100	21	16	16	32
22	15.7	27.8	22	19.5	37.8	22	18.6	35.3	5%	22	34.4	22	52.9	22	53	53	106	22	-40	-40	-80	22	13	13	26
23	10.4	19.5	23	13.8	29.9	23	13.0	27.3	5%	23	26.7	23	39.6	23	40	40	80	23	-30	-30	-60	23	10	10	20
Daily Tot.	705.2	1,083.2	Daily Tot.	862.5	1,516.1	Daily Tot.	823.2	1,407.9		Daily Tot.	1,290.8	Daily Tot.	2,114.0	Daily Tot.	2,123	2,123	4,246	Daily Tot.	-1,601	-1,601	-3,202	Daily Tot.	522	522	1,044

Note: Represents average weekday (Monday through Thursday) transactions between October 1, 2019 and October 31, 2019.  
Source: Maverik

Note: Above percentages derived from PM peak hour observations on September 29, 2020 at Maverik Gas Station located at 425 South Redwood Road, Salt Lake City, UT. Additional counts to verify local conditions collected in September 2020 at similar gas station and convenience market/restaurant facility in Roseville.  
Source: Fehr & Peers

Note: This step is taken to account for customers who complete both a a fuel transaction and an in store transaction.

Note: Each transaction represents one inbound trip and one outbound trip.

Source: ITE *Trip Generation Handbook*



SimTraffic Post-Processor  
Average Results from 10 Runs  
Volume and Delay by Movement

Power Inn Maverik  
Existing Plus 14th Ave Extension  
AM Peak Hour

Intersection 1                      Power Inn Road/14th Ave                      Signal

Direction	Movement	Demand Volume (vph)	Served Volume (vph)		Total Delay (sec/veh)		LOS
			Average	Percent	Average	Std. Dev.	
NB	Left Turn	165	155	94.1%	66.7	5.6	E
	Through	1,500	1,492	99.5%	34.4	5.5	C
	Right Turn	30	24	80.0%	17.4	10.3	B
	Subtotal	1,695	1,671	98.6%	37.2	5.3	D
SB	Left Turn	105	102	97.5%	48.5	2.4	D
	Through	900	934	103.8%	39.7	3.6	D
	Right Turn	250	271	108.3%	9.0	2.0	A
	Subtotal	1,255	1,307	104.2%	34.2	3.0	C
EB	Left Turn	230	221	96.2%	36.0	2.6	D
	Through	105	100	95.6%	38.2	5.7	D
	Right Turn	100	106	105.6%	11.3	2.7	B
	Subtotal	435	427	98.2%	30.5	2.4	C
WB	Left Turn	25	23	92.8%	105.2	49.6	F
	Through	175	175	99.9%	115.9	53.6	F
	Right Turn	100	92	92.0%	45.6	44.2	D
	Subtotal	300	290	96.7%	92.9	50.9	F
Total		3,685	3,696	100.3%	39.9	4.1	D

SimTraffic Post-Processor  
 Average Results from 10 Runs  
 Queue Length

Power Inn Maverik  
 Existing Plus 14th Ave Extension  
 AM Peak Hour

Intersection 1

Power Inn Road/14th Ave

Signal

Direction	Lane Group	Storage (ft)	Average Queue (ft)		95th Queue (ft)		Maximum Queue (ft)		Block Time	
			Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Pocket	Upstream
EB	Left Turn	200	80	9	153	23	146	23	0%	0%
	Left/Through	1,774	129	14	199	26	199	36	5%	0%
	Right Turn	165	44	18	91	47	96	64	0%	0%
NB	U/Left Turns	190	51	22	117	45	126	41	0%	0%
	Left Turn	190	170	34	277	19	240	1	0%	0%
	Through	973	462	65	592	125	572	125	35%	0%
	Through/Right	160	203	9	221	13	210	0	11%	0%
SB	U/Left Turns	285	103	24	197	61	211	90	0%	0%
	Through	854	255	44	344	74	338	74	10%	0%
	Right Turn	1,854	72	15	131	35	142	29	0%	0%
WB	Left Turn	160	51	27	134	70	140	70	0%	0%
	Through	1,590	290	139	431	149	419	138	41%	0%
	Right Turn	160	109	32	215	33	185	1	0%	0%

SimTraffic Post-Processor  
Average Results from 10 Runs  
Volume and Delay by Movement

Power Inn Maverik  
Existing Plus 14th Ave Extension  
PM Peak Hour

Intersection 1                      Power Inn Road/14th Ave                      Signal

Direction	Movement	Demand Volume (vph)	Served Volume (vph)		Total Delay (sec/veh)		LOS
			Average	Percent	Average	Std. Dev.	
NB	Left Turn	165	159	96.5%	54.1	5.1	D
	Through	1,000	997	99.7%	27.0	2.2	C
	Right Turn	15	14	96.0%	8.1	7.5	A
	Subtotal	1,180	1,170	99.2%	30.4	2.1	C
SB	Left Turn	130	132	101.5%	63.6	4.1	E
	Through	1,360	1,356	99.7%	35.5	8.1	D
	Right Turn	350	338	96.5%	6.5	0.9	A
	Subtotal	1,840	1,825	99.2%	32.4	6.1	C
EB	Left Turn	510	448	87.8%	118.8	19.6	F
	Through	110	114	103.3%	110.0	20.9	F
	Right Turn	250	239	95.7%	96.1	20.7	F
	Subtotal	870	800	92.0%	111.0	19.7	F
WB	Left Turn	40	41	102.0%	97.9	37.8	F
	Through	175	160	91.2%	119.1	51.2	F
	Right Turn	40	32	81.0%	41.8	35.9	D
	Subtotal	255	233	91.3%	105.7	47.9	F
Total		4,145	4,029	97.2%	51.7	4.3	D

SimTraffic Post-Processor  
Average Results from 10 Runs  
Queue Length

Power Inn Maverik  
Existing Plus 14th Ave Extension  
PM Peak Hour

Intersection 1

Power Inn Road/14th Ave

Signal

Direction	Lane Group	Storage (ft)	Average Queue (ft)		95th Queue (ft)		Maximum Queue (ft)		Block Time	
			Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Pocket	Upstream
EB	Left Turn	200	213	6	242	10	225	0	5%	0%
	Left/Through	2,555	1,022	237	1,325	160	1,315	190	55%	0%
	Right Turn	165	168	17	234	26	190	0	6%	0%
NB	U/Left Turns	190	54	13	128	34	136	29	0%	0%
	Left Turn	190	134	19	230	22	211	11	0%	0%
	Through	1,295	238	20	343	45	348	51	17%	0%
	Through/Right	160	159	11	212	19	185	0	3%	0%
SB	U/Left Turns	285	137	30	232	54	243	59	0%	0%
	Through	854	258	67	384	137	436	228	14%	0%
	Right Turn	1,854	53	10	98	13	102	21	0%	0%
WB	Left Turn	160	72	29	162	61	159	54	0%	0%
	Through	1,620	272	107	389	165	369	148	43%	0%
	Right Turn	160	64	31	170	59	183	4	0%	0%

Intersection 1                      Power Inn Road/14th Ave                      Signal

Direction	Movement	Demand Volume (vph)	Served Volume (vph)		Total Delay (sec/veh)		LOS
			Average	Percent	Average	Std. Dev.	
NB	Left Turn	160	126	79.0%	149.2	10.1	F
	Through	1,507	1,352	89.7%	119.5	7.9	F
	Right Turn	44	46	103.6%	123.0	21.0	F
	Subtotal	1,711	1,524	89.1%	122.1	7.2	F
SB	Left Turn	149	136	91.5%	75.5	10.6	E
	Through	877	934	106.5%	40.4	7.4	D
	Right Turn	241	252	104.7%	16.3	4.3	B
	Subtotal	1,267	1,323	104.4%	39.5	6.8	D
EB	Left Turn	233	219	94.1%	38.1	4.2	D
	Through	109	115	105.7%	39.2	3.6	D
	Right Turn	97	111	114.6%	13.6	5.9	B
	Subtotal	439	446	101.5%	32.3	2.9	C
WB	Left Turn	59	62	104.4%	58.6	13.0	E
	Through	190	207	109.1%	54.5	6.1	D
	Right Turn	86	93	107.9%	10.8	1.9	B
	Subtotal	335	362	107.9%	44.4	5.7	D
Total		3,752	3,654	97.4%	73.7	2.9	E

SimTraffic Post-Processor  
Average Results from 10 Runs  
Queue Length

Power Inn Maverik  
Existing Plus 14th Ave Extension Plus Project  
AM Peak Hour

Intersection 1

Power Inn Road/14th Ave

Signal

Direction	Lane Group	Storage (ft)	Average Queue (ft)		95th Queue (ft)		Maximum Queue (ft)		Block Time	
			Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Pocket	Upstream
EB	Left Turn	200	86	18	167	40	174	37	0%	0%
	Left/Through	1,822	151	15	216	33	225	33	7%	0%
	Right Turn	165	45	16	91	48	99	66	0%	0%
NB	U/Left Turns	190	56	14	95	30	96	31	0%	0%
	Left Turn	190	147	43	260	47	240	1	0%	0%
	Through	973	970	47	1,067	63	1,011	17	54%	49%
	Through/Right	160	207	2	215	3	210	0	54%	0%
SB	U/Left Turns	285	153	29	249	31	233	8	1%	1%
	Through	236	261	39	345	31	313	8	22%	22%
	Right Turn	1,236	80	17	174	38	178	33	0%	0%
WB	Left Turn	160	63	18	104	23	103	23	0%	0%
	Through	279	100	16	148	30	148	35	1%	0%
	Right Turn	160	46	10	86	29	100	48	0%	0%

Intersection 1                      Power Inn Road/14th Ave                      Signal

Direction	Movement	Demand Volume (vph)	Served Volume (vph)		Total Delay (sec/veh)		LOS
			Average	Percent	Average	Std. Dev.	
NB	Left Turn	165	167	101.3%	71.5	5.5	E
	Through	1,006	1,019	101.3%	40.9	5.8	D
	Right Turn	19	17	90.5%	23.5	15.7	C
	Subtotal	1,190	1,204	101.1%	44.9	5.1	D
SB	Left Turn	178	148	83.1%	126.7	10.2	F
	Through	1,330	1,222	91.9%	86.0	5.9	F
	Right Turn	345	336	97.3%	51.1	5.2	D
	Subtotal	1,853	1,706	92.1%	82.6	5.6	F
EB	Left Turn	515	504	97.8%	71.9	24.5	E
	Through	114	110	96.1%	70.7	27.6	E
	Right Turn	247	266	107.7%	51.8	24.3	D
	Subtotal	876	879	100.4%	65.7	24.7	E
WB	Left Turn	92	85	92.2%	64.3	7.0	E
	Through	193	187	96.8%	57.8	4.4	E
	Right Turn	40	45	112.0%	8.9	1.8	A
	Subtotal	325	316	97.4%	52.4	2.7	D
Total		4,244	4,105	96.7%	65.6	4.1	E

SimTraffic Post-Processor  
 Average Results from 10 Runs  
 Queue Length

Power Inn Maverik  
 Existing Plus 14th Ave Extension Plus Project  
 PM Peak Hour

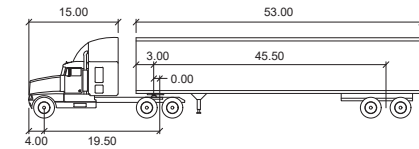
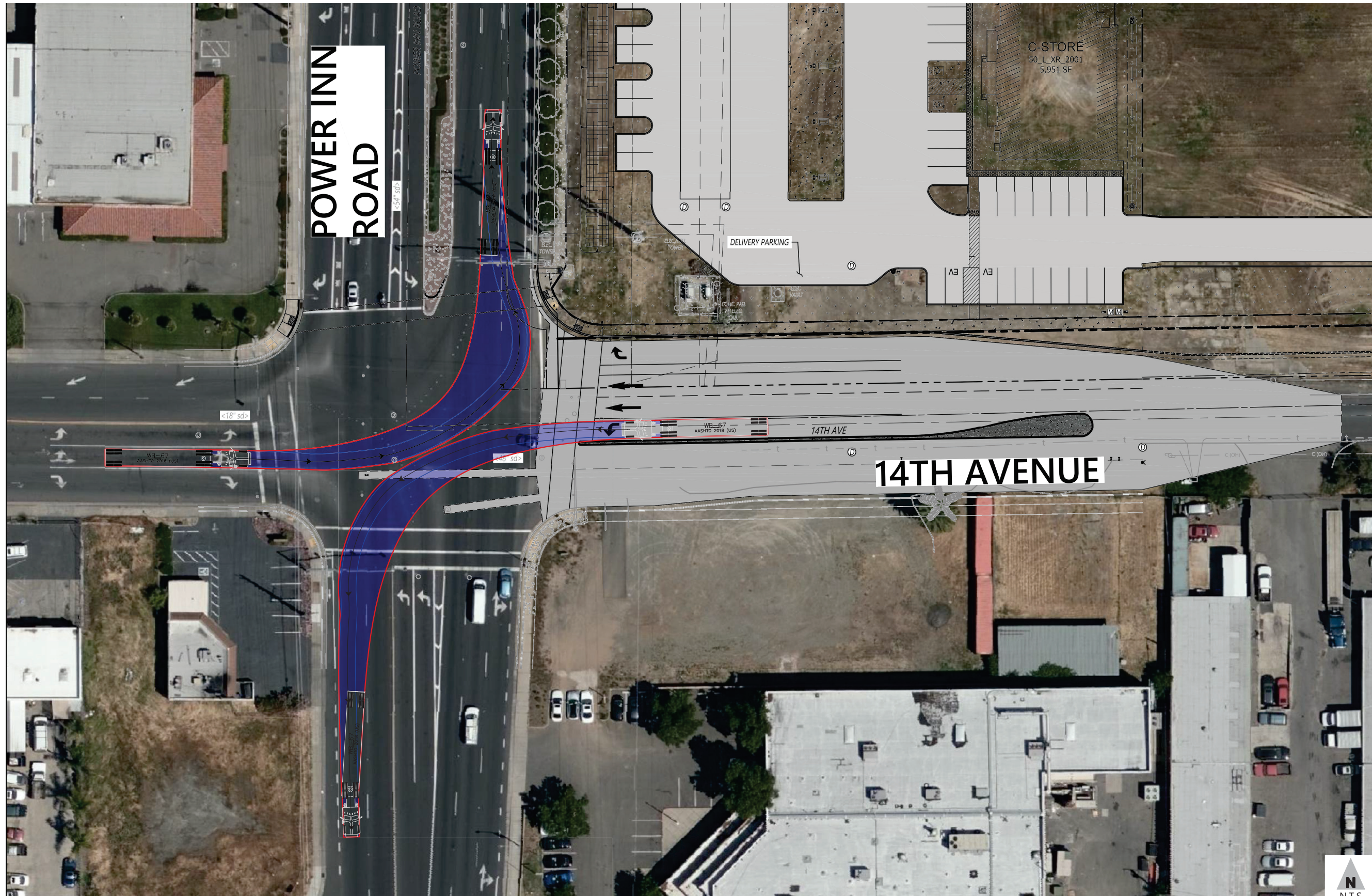
Intersection 1

Power Inn Road/14th Ave

Signal

Direction	Lane Group	Storage (ft)	Average Queue (ft)		95th Queue (ft)		Maximum Queue (ft)		Block Time	
			Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.	Pocket	Upstream
EB	Left Turn	200	205	12	242	7	224	0	2%	0%
	Left/Through	1,327	548	151	799	253	852	200	43%	0%
	Right Turn	165	166	9	241	17	190	0	2%	0%
NB	U/Left Turns	190	97	26	186	47	170	30	0%	0%
	Left Turn	190	166	23	247	18	214	1	2%	0%
	Through	973	356	41	485	60	473	65	33%	0%
	Through/Right	160	172	11	202	14	185	0	7%	0%
SB	U/Left Turns	285	174	18	245	18	216	1	5%	5%
	Through	216	291	3	302	13	306	17	56%	57%
	Right Turn	1,216	103	17	202	39	221	33	0%	1%
WB	Left Turn	160	93	21	162	19	167	22	1%	0%
	Through	279	119	22	181	20	184	26	2%	0%
	Right Turn	160	25	8	52	14	51	18	0%	0%





WB-67

	feet		
Tractor Width	: 8.00	Lock to Lock Time	: 8.0
Trailer Width	: 8.50	Steering Angle	: 28.4
Tractor Track	: 8.00	Articulating Angle	: 75.0
Trailer Track	: 8.50		



