



MEMORANDUM

Date: January 2, 2025
To: Luke Schwartz and Adam Fukushima, City of San Luis Obispo
From: Joe Fernandez and Michelle Matson, CCTC
Subject: **Higuera Complete Street Project - Traffic Operations Evaluation**

This memorandum evaluates the operational effects of the Higuera Complete Street project, which would enhance pedestrian and bicycle infrastructure in the City of San Luis Obispo along the Higuera Street corridor between Los Osos Valley Road and Marsh Street, on Madonna Road from the US 101 Southbound Ramps to Higuera Street, and on Bridge Street, Corrida Drive, and Woodbridge Street east of Higuera Street with neighborhood greenway improvements.

SUMMARY

Approximately 390 collisions were reported on the Higuera Street corridor between Marsh Street and Los Osos Valley Road within the study area in the ten-year period from 2014 through 2023, including 41 bicycle collisions and 14 pedestrian collisions. There were four bicycle collisions that resulted in a severe injury as well as two bicycle and one pedestrian collision that resulted in fatalities.

The proposed project would improve bicycle facility delineation and would reallocate roadway space to improve cyclist comfort and safety. In addition, the project would improve pedestrian accessibility and crossing experience with the addition of ADA-compliant curb ramps and high-visibility crosswalk markings.

A road diet would be implemented on Higuera Street between Bridge Street and Margarita Avenue. The project would also modify the lane configurations and add bicycle and pedestrian signal phase at Higuera Street/Madonna Road (#4), modify the signal phasing and add a bicycle signal phase at Higuera Street/Los Osos Valley Road (#12), and install a traffic signal at Higuera Street/Elks Lane (#6). On the Madonna Road corridor, the project currently proposes to eliminate one of the westbound travel lanes at the Higuera Street/US 101 Southbound Ramp (#13) intersection. The above intersections would operate acceptably at level of service (LOS) D or better with the project except Higuera Street/Los Osos Valley Road (#12) which would operate at LOS E under Near Term and Cumulative Conditions during the PM peak hour.

PROJECT DESCRIPTION

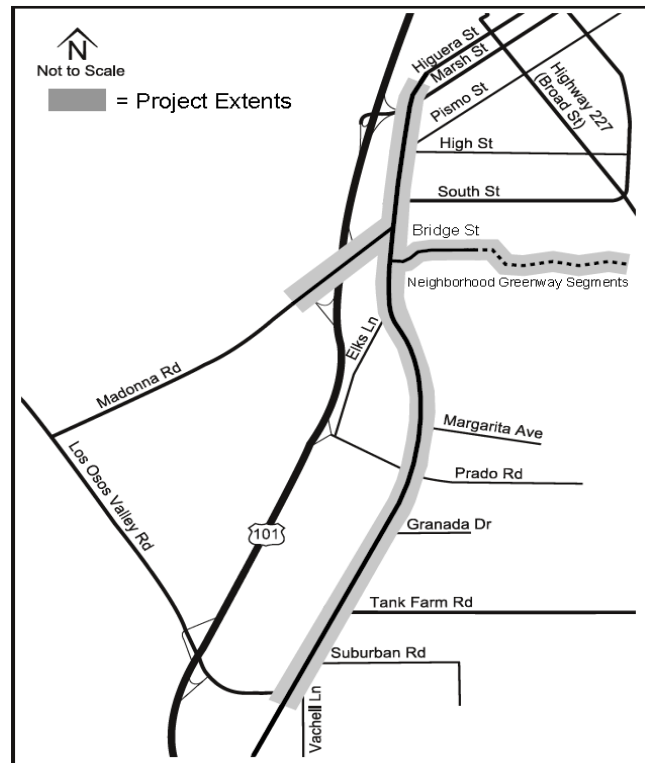
The study corridor is a key north-south route for all modes of travel in the City. The City's Active Transportation Plan proposes protected bicycle lanes along Higuera Street as a Tier 1 (highest) priority, and an Active Transportation Program Grant was recently awarded to construct the project. The project also includes proposed bikeway enhancements on Madonna Road between Higuera Street and the US 101 SB Ramps and a neighborhood greenway connection east of Higuera Street. This report is based on the 65% design plans and

comments prepared for the project and evaluates the project effects on traffic operations and safety for all users.

Exhibit 1 shows the project extents. The project includes 4.6 miles of protected bike lanes, buffered bike lanes, and various intersection improvements (including high visibility crosswalks, leading pedestrian intervals, a traffic signal installation, and signal safety upgrades) designed to increase safety and visibility of bicyclists and pedestrians. The project is intended to create safer routes to Hawthorne Elementary School and Laguna Middle School, as well as safe routes to school bus stops for elementary, middle, and high school students living along the corridor.

Unhoused residents served by the City's only homeless shelter on Prado Road will have improved access to transit and services. Similarly, Cal Poly students and other area residents will benefit from improved connectivity to the southern areas of the City.

Exhibit 1: Project Extents



Alternatives Considered but Discarded

This section describes alternatives that were considered in the project development process but were excluded from the current concepts.

Road Diet Limits

Road diets reallocate vehicle travel lanes for other uses and modes of travel, and have been shown to provide operational and safety benefits to all users. Four-lane undivided roadways have a history of relatively high crash rates as traffic volumes increase and as the inside lane is shared by higher-speed through traffic and left-turning vehicles (FHWA, 2014). Road diets typically convert a four-lane undivided road to a three-lane undivided road made up of two through lanes and a center turn lane. Research has shown that road diets reduce crashes, with various studies reporting reductions in crashes ranging from 19 percent to 47 percent (CMF Clearinghouse, 2023).

Generally, road diets may be appropriate when two-way peak hour volumes are below 1,750 vehicles per hour (FHWA, 2014). **Exhibit 2** shows the existing PM peak hour volumes along the corridor compared to this threshold. The PM peak hour is typically the highest volume period of the day. Intersection volume flow and lane geometry characteristics play an important role, but this generic threshold is used as a starting point for concept refinement before more detailed analysis of intersection operations.

Exhibit 2: Existing PM Peak Hour Volumes

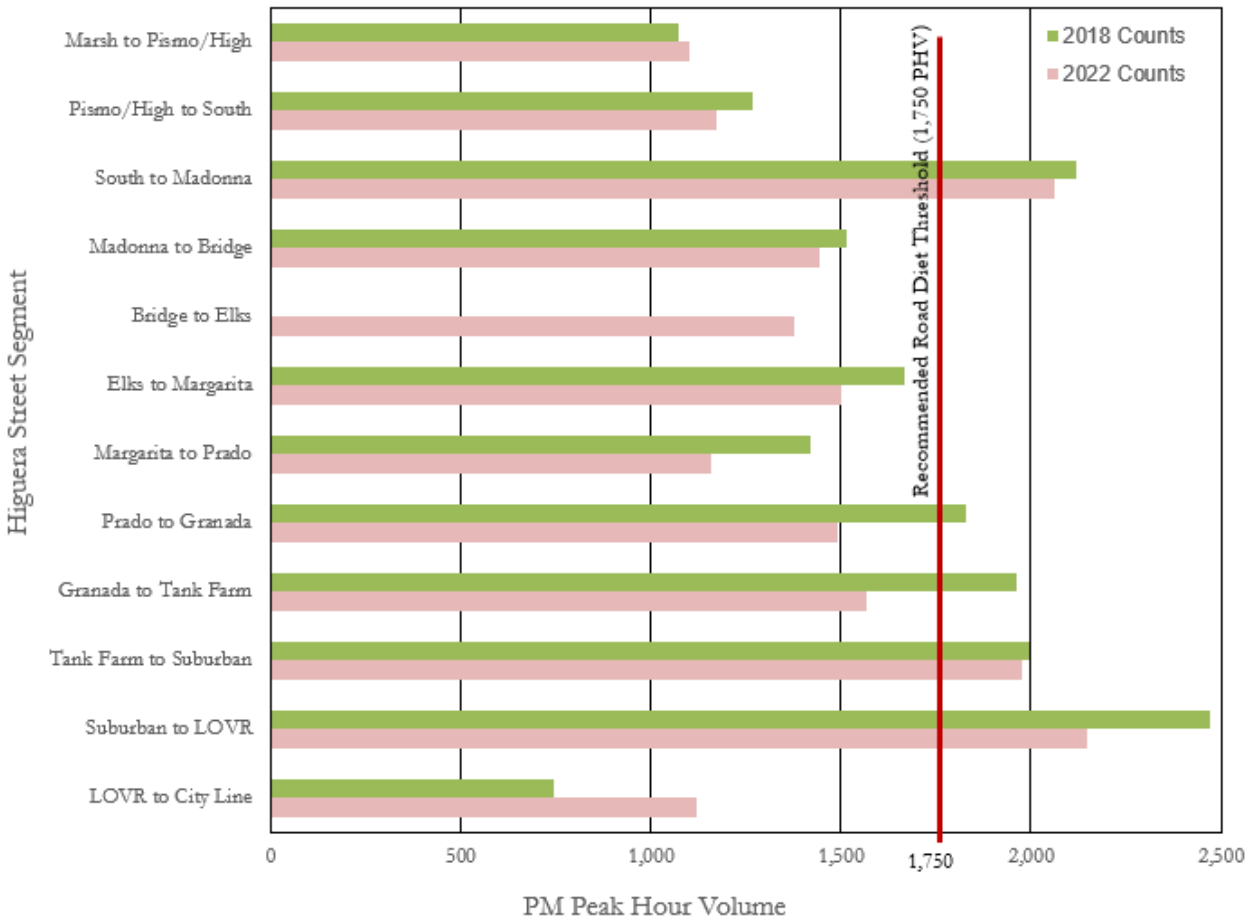


Exhibit 2 shows that the portion of the corridor north of South Street currently carries volumes below 1,750 vehicles per hour. The segment from South Street to Madonna Road is above this level, then volumes drop below the threshold until Prado Road. These trends and detailed intersection level operations analysis were used to inform initial project designs to determine where lane reductions could be feasible and appropriate based on this analysis. The road diet is proposed along Higuera Street between Bridge Street and Margarita Street only as discussed further below.

South Street to Madonna Road Segment

Initial design concepts considered narrowing the southbound approach to Higuera Street/Madonna Road (#4) to provide a single southbound through lane instead of the dual lanes that currently exist and that are proposed in the current design. This would increase the available space for bicycle facilities, enabling either a wider bike lane and continuous separation from vehicular traffic on the southbound side and/or the ability to shift the median to provide width for a continuous northbound bike lane between Madonna Road and South Street. The northbound bike lane currently ends between Madonna Road and South Street, forcing bicyclists to share the travel lane on Higuera Street, a 30 MPH roadway.

Narrowing the southbound approach would create significant queuing and vehicle delay in this constrained portion of the corridor. Using the existing volumes, the southbound average and 95th percentile queues would more than double with a single through lane, with 95th percentile queues spilling back through and beyond the

South Street intersection. This condition would worsen as traffic volumes grow with approved and pending projects in the area and has the potential to cause safety issues as queued vehicles block crosswalks and sight lines in the area. Retaining the dual southbound through lane design as currently proposed would preclude the ability to provide a continuous northbound bike lane, presenting safety and comfort concerns for cyclists.

The dual southbound lanes are analyzed herein. The project analysis does include prohibiting southbound left turns at Higuera Street/Madonna Road (#4) with volumes diverted to the Bridge Street intersection where a dedicated turn pocket is available. In addition, the project will convert one of the northbound through lanes at the intersection into a left turn lane which improves operations at the intersection into the future, particularly during construction of the Prado Creek Bridge, which will likely shift traffic to the Madonna Road/US 101 interchange.

The Higuera Street/Madonna Road (#12) intersection was also evaluated for an additional eastbound bicycle phase as well as a bicycle scramble phase which would operate at LOS F and LOS E during the PM peak hour, respectively. A southbound bicycle and pedestrian only signal phase with overlapping northbound and southbound through vehicles is currently proposed and analyzed herein.

Margarita Avenue to Los Osos Valley Road Segment

Initial concept development considered extending the road diet south of Margarita Avenue. This 1.1-mile segment includes six signalized intersections. Applying a road diet configuration to a corridor with frequent signalized intersections will have a larger impact on automobile operations than it would on a corridor with fewer signals (FHWA, 2014).

The Margarita Avenue/Higuera Street (#7) intersection was evaluated using existing volumes to determine the effect of continuing the road diet through this intersection. The wide median on Margarita Avenue requires split phasing on the side street approaches. This increases the green time allocated to the side streets at the expense of major street movements. Narrowing the southbound approach to a single lane would result in average queues blocking the DMV driveway, and 95th percentile queues over 550 feet long, more than double the current lengths. We recommend transitioning to a two-lane section north of Margarita Avenue, as reflected in the current design.

The Higuera Street segment from Prado Road to Tank Farm Road had PM peak hour volumes below 1,500 in 2022 and over 1,750 in 2018. The planned Prado Road overcrossing will significantly increase volumes on this portion of the corridor and reducing vehicular travel lanes is not recommended. Higuera Street south of Tank Farm Road currently carries over 1,750 vehicles per hour, indicating that a road diet is inappropriate.

The Higuera Street/Los Osos Valley Road (#12) intersection was evaluated for a southbound pedestrian and bicycle signal phase. However, the intersection would operate at LOS F and further increase queues. A bicycle only signal phase with overlapping northbound and southbound through vehicles is currently proposed and analyzed herein.

Madonna Road Overpass

Preliminary analysis showed that a Class I path with a bicycle signal phase on the overpass would operate at LOS F at the Southbound Ramps during the PM peak hour with undesirable queues. Class IV protected bike lanes with a bike signal phase on both sides of the roadway would operate at LOS D and would increase queuing on the ramps.

The City is planning to further explore the Class I path on the north side of the overpass with Caltrans. However, it is not part of the current project, which will restripe the corridor and remove one of the westbound

lanes at the Higuera Street/ US 101 Southbound Ramps (#13) intersection. The current design includes Highway Design Manual (HDM) standard lane width for ease of approval.

SAFETY ANALYSIS

Traffic collision data was obtained from the Statewide Integrated Traffic Records System (SWITRS) and the City for Higuera Street and Madonna Road in the project vicinity. **Table 1** summarizes the collision history and severity for the ten-year period between 2014 and 2023:

Table 1: Collision Summary (2014-2023)

Collision Summary (2014-2023)											
Location	Collision Severity					Pedestrian/Bike Collisions					
	Total	Fatal	Severe Injury	Other Injury	PDO	All Ped.	All Bike	Ped. Severe Injury	Bike Severe Injury	Ped. Fatal	Bike Fatal
1. Higuera St/Marsh St	20	1	1	2	16	0	0	0	0	0	0
2. Higuera St/High St/Pismo St	23	0	3	13	7	1	6	0	1	0	0
3. Higuera St/South St	45	1	0	13	31	2	3	0	0	1	0
4. Higuera St/Madonna Rd	41	0	0	16	25	0	4	0	0	0	0
5. Higuera St/Bridge St	11	0	1	5	5	0	1	0	1	0	0
6. Higuera St/Elks Ln	13	0	0	8	5	1	0	0	0	0	0
7. Higuera St/Margarita Ave	18	0	1	10	7	0	2	0	1	0	0
8. Higuera St/Prado Rd	27	1	1	13	12	3	4	0	0	0	1
9. Higuera St/Granada Dr	9	0	0	4	5	1	1	0	0	0	0
10. Higuera St/Tank Farm Rd	23	0	0	12	11	1	2	0	0	0	0
11. Higuera St/Suburban Rd	24	1	0	11	12	0	4	0	0	0	1
12. Higuera St/LOVR	29	0	1	5	23	0	0	0	0	0	0
Higuera Other (LOVR to Marsh)	107	1	3	50	53	5	14	0	1	0	0
HIGUERA TOTAL	390	5	11	162	212	14	41	0	4	1	2
Madonna (SB Ramps to Higuera)	80	0	1	34	45	5	4	0	0	0	0

PDO=Property Damage Only
 Source: Statewide Integrated Traffic Records System, City of San Luis Obispo, CCTC, 2024.

There were 390 collisions reported on the Higuera Street corridor between Marsh Street and Los Osos Valley Road within the study area in the ten-year period from 2014 through 2023, fewer than the 398 collisions reported from 2012 to 2021. Between 2014 and 2023, 41 bicycle collisions and 14 pedestrian collisions were reported on the corridor. While bike and pedestrian trips represent about 15% of citywide mode share (ACS Commute Data), bicycles and pedestrians represent 60% and 33% of fatal and severe injury collisions, respectively, in the study area.

The pedestrian fatality occurred north of the South Street intersection due to a pedestrian violation. The two fatal bicycle collisions occurred at intersections, one due to an improper vehicle turning movement and one due to a wrong way cyclist and an impaired vehicle driver. Four bicycle severe injury collisions were reported including one vehicle right-of-way violation when entering traffic, two improper vehicle turning movements, and one unknown cause. Two vehicle hit object fatal collisions occurred, one south of Chumash Lane due to improper turning and one at Marsh Street due to improper driving. Three severe injury collisions were reported including a hit object collision south of Margarita Avenue, a broadside collision south of Fontana Way, and a bicycle collision south of Walker Street.

Table 2 summarizes the collision factors and types for the ten-year period between 2014 and 2023:

Table 2: Collision Factors and Types (2014-2023)

Collision Factors and Types (2014-2023)													
Location	Total	Collision Factor						Collision Type					
		Speed	Turning	ROW	Signals/Signs	DUI	Other	Broad-side	Rear End	Hit Object	Side-swipe	Head On	Other
1. Higuera St/Marsh St	20	0	5	0	3	5	7	3	1	12	4	0	0
2. Higuera St/High St/Pismo St	23	8	5	3	2	0	5	7	6	4	4	1	1
3. Higuera St/South St	45	8	10	4	5	4	14	10	9	7	15	2	2
4. Higuera St/Madonna Rd	41	12	10	1	1	3	14	4	21	4	7	4	1
5. Higuera St/Bridge St	11	3	5	1	1	0	1	6	4	1	0	0	0
6. Higuera St/Elks Ln	13	3	1	3	0	2	4	3	1	3	3	2	1
7. Higuera St/Margarita Ave	18	0	4	4	4	2	4	11	1	2	1	2	1
8. Higuera St/Prado Rd	27	7	1	2	5	1	11	4	8	0	7	5	3
9. Higuera St/Granada Dr	9	2	1	1	2	0	3	3	2	1	1	1	1
10. Higuera St/Tank Farm Rd	23	8	6	1	2	0	6	6	11	3	2	0	1
11. Higuera St/Suburban Rd	24	2	4	5	7	2	4	16	2	2	1	3	0
12. Higuera St/LOVR	29	7	8	1	3	4	6	4	7	7	3	6	2
Higuera Other (LOVR to Marsh)	107	27	26	23	5	3	23	46	20	17	11	3	10
HIGUERA TOTAL	390	87	86	49	40	26	102	123	93	63	59	29	23
Madonna (SB Ramps to Higuera)	80	22	8	8	6	6	30	16	35	8	10	3	8

ROW = Right-of-Way Violation; DUI: Driving Under the Influence.
 Source: Statewide Integrated Traffic Records System, City of San Luis Obispo, CCTC, 2024.

Approximately half of collisions were due to unsafe speed or improper turning. The primary collision types were broadside and rear end with approximately 30 percent of total collisions each.

Safety Benefits of the Proposed Project

Increased bike delineation of protected bike lanes, buffered bike lanes, green bike lanes, bike boxes, and two stage bike turn boxes will increase visibility for cyclists and guide cyclists through the corridor. In addition, the project would restripe all crosswalks with ladder striping to increase pedestrian visibility.

The project proposes the installation of accessible pedestrian signal (APS) push buttons, countdown pedestrian signal heads, leading pedestrian intervals (LPI), and high-visibility signal backplates throughout the corridor where such features do not currently exist. Crash reduction factors (CRF) estimate the reduction in collisions resulting from specific improvements and are presented as estimated percent reductions as reported by the Federal Highway Administration. Where multiple safety improvements are installed, the effect of each CRF is multiplicative rather than additive. CRFs applicable to the project include:

- 15% reduction for all collision types when improving signal timing.
- 15% reduction for pedestrian and bicycle collisions when installing advanced stop bar before crosswalk (Bicycle Box).

- 15% reduction for all collision types when adding three-inch yellow retroreflective sheeting to signal backplates.
- 25% reduction for pedestrian and bicycle collisions when installing countdown pedestrian signal heads.
- 30% reduction in all collisions when adding protected left turn phasing.
- 30% reduction in all collisions for a road diet.
- 45% reduction in pedestrian and bicycle collisions when installing separated bike lanes.
- 60% reduction in pedestrian and bicycle collisions when adding a LPI.

The design elements proposed as part of the project include proven best practices for reducing the frequency and severity of collisions for all road users, particularly bicycles and pedestrians.

TRAFFIC OPERATIONS

Traffic operations were analyzed at the following intersections using the Synchro 11 software package applying the Highway Capacity Manual (HCM) methods and 2022 counts unless otherwise noted below:

1. Higuera Street/Marsh Street
2. Higuera Street/High Street/Pismo Street
3. Higuera Street/South Street
4. Higuera Street/Madonna Road
5. Higuera Street/Bridge Street
6. Higuera Street/Elks Lane (2023 count)
7. Higuera Street/Margarita Avenue
8. Higuera Street/Prado Road
9. Higuera Street/Granada Drive
10. Higuera Street/Tank Farm Road
11. Higuera Street/Suburban Road
12. Higuera Street/Los Osos Valley Road (2023 count)
13. Madonna Road/US 101 Southbound Ramps
14. Madonna Road/US 101 Northbound Ramps
15. Higuera Street/Chumash Drive (2024 count)

The City's Circulation Element specifies a performance standard of level of service (LOS) D or better for arterials like South Higuera Street and Madonna Road. The City's Multimodal Transportation Impact Study Guidelines identify thresholds for local policy consistency, noting that a project may have a significant impact if it causes or exacerbates 95th percentile turning movement queues exceeding available turn pocket capacity and presents a contextually significant safety hazard.

Existing Conditions

The existing vehicular traffic volumes are shown in **Attachment A** and the count data is included as **Attachment B**. The City is currently updating minimum green and yellow times at traffic signals to comply with the California Manual on Uniform Traffic Control Devices (CAMUTCD) minimum bike timing and recommended yellow clearance intervals. These timing changes were assumed to be in place for all scenarios and will have minimal effect on delays and queuing.

Table 3 shows the existing peak hour auto level of service (LOS) at the study intersections. The Synchro output sheets including queue reports are included in **Attachment C**.

Table 3: Existing Intersection Levels of Service

Existing Intersection Levels of Service			
Intersection	Peak Hour	Existing Delay ¹	LOS
1. Higuera St/Marsh St	AM	18.1	B
	PM	20.8	C
2. Higuera St/High St/Pismo St	AM	18.8	B
	PM	36.0	D
3. Higuera St/South St	AM	26.5	C
	PM	26.7	C
4. Higuera St/Madonna Rd	AM	19.6	B
	PM	25.4	C
5. Higuera St/Bridge St	AM	11.5	B
	PM	15.7	C
6. Higuera St/Elks Ln	AM	17.3	C
	PM	59.5	F
7. Higuera St/Margarita Ave	AM	10.0	B
	PM	9.9	A
8. Higuera St/Prado Rd	AM	17.4	B
	PM	19.9	B
9. Higuera St/Granada Dr	AM	8.8	A
	PM	10.8	B
10. Higuera St/Tank Farm Rd	AM	21.1	C
	PM	23.7	C
11. Higuera St/Suburban Rd	AM	6.5	A
	PM	13.7	B
12. Higuera St/Los Osos Valley Rd	AM	17.2	B
	PM	52.7	D
13. Madonna Rd/US 101 SB Ramps	AM	15.4	B
	PM	25.5	C
14. Madonna Rd/US 101 NB Ramps	AM	9.4	A
	PM	21.5	C
15. Higuera St/Chumash Dr	AM	12.9	B
	PM	14.5	B

1. HCM 6th or HCM 2000 average control delay in seconds per vehicle. For side-street-stop controlled intersections, the worst approach's delay is reported.
Note: Unacceptable operations at City intersections shown in bold text.

All intersections operate acceptably at LOS D or better except the side-street stop-controlled intersection of Higuera Street/Elks Lane (#6) during the PM peak hour. The peak hour traffic signal warrant is currently met and the intersection will be upgraded to a traffic signal with the project.

The following existing queue deficiencies are noted:

- Higuera Street/ South Street (#3): the westbound left, northbound left, and southbound left turn queues exceed the storage lengths during one or more peak hours.

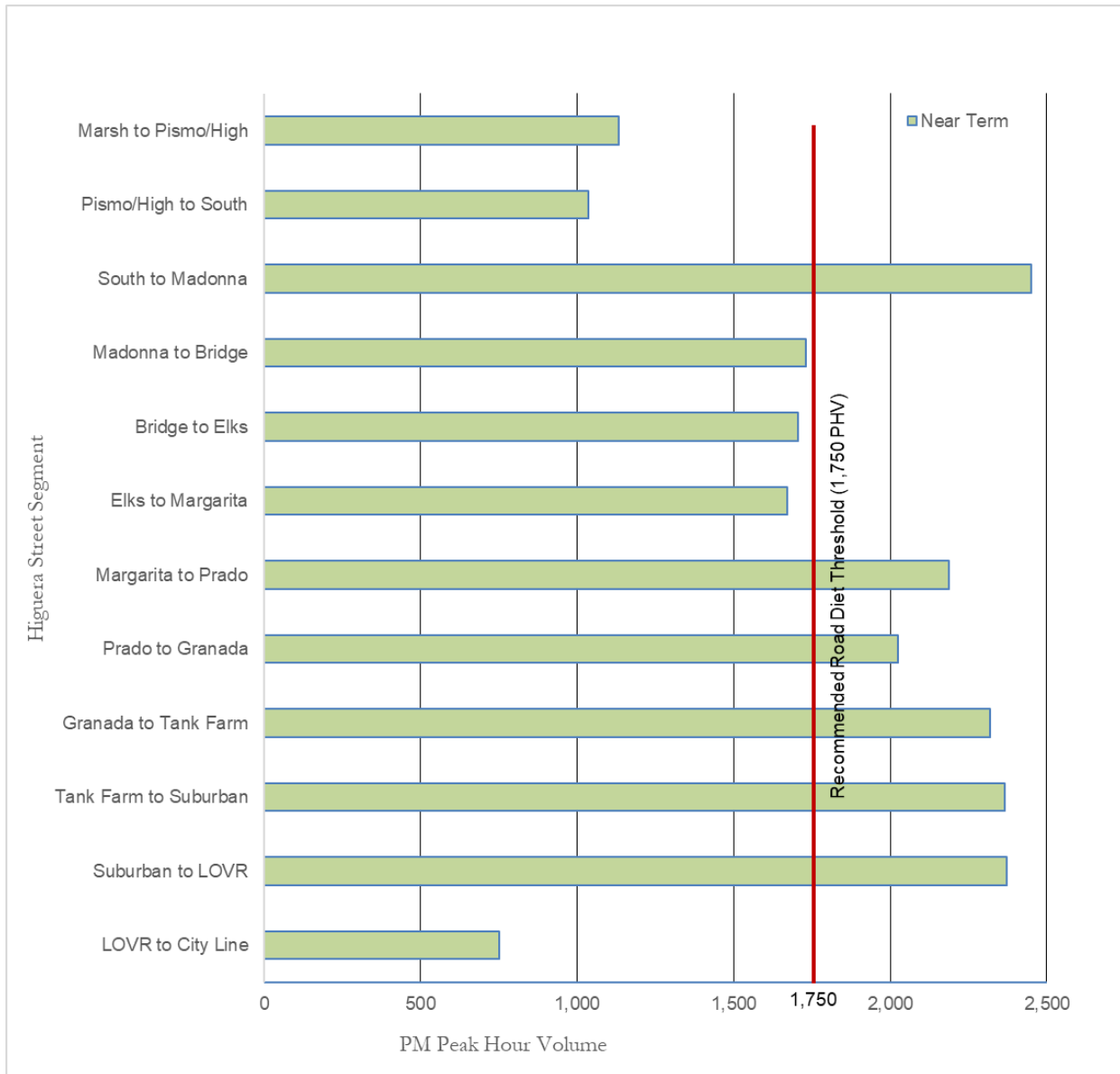
- Higuera Street/ Madonna Road (#4): the northbound left turn queue exceeds the storage length in the PM peak hour.
- Higuera Street/ Prado Road (#8): the northbound left turn queue exceeds the storage length in both the AM and PM peak hours.
- Higuera Street/ Los Osos Valley Road (#12): the eastbound right queue exceeds the storage length in the AM and PM peak hour.

Future Year Scenarios

Peak hour turning movement forecasts were developed for the Near Term (2030) and Cumulative (2040) conditions analysis using the City's Travel Demand Model (TDM). The Near Term forecasts include significant approved and pending land use projects such as San Luis Ranch, Avila Ranch, and Froom Ranch but exclude planned improvements to the US 101/Prado Road interchange, the Prado Bridge Replacement and related intersection improvements at the Higuera Street/Prado Road (#8) intersection, or any other major network changes. This is conservative since it assumes all the major approved projects in the City are built and occupied prior to completion of key improvements along Prado Road which will reduce travel demand along portions of the Higuera Street corridor.

Exhibit 3 shows planning-level peak hour volume forecasts along the corridor under Near Term conditions compared to the road diet threshold. The northern portion of the corridor in the Near Term is expected to carry fewer than 1,750 vehicles per hour. The segment from Madonna Road to South Street is above this level, then volumes drop below the threshold until Margarita Avenue through Los Osos Valley Road. This indicates that the road diet is expected to perform acceptably under the highest volume scenario.

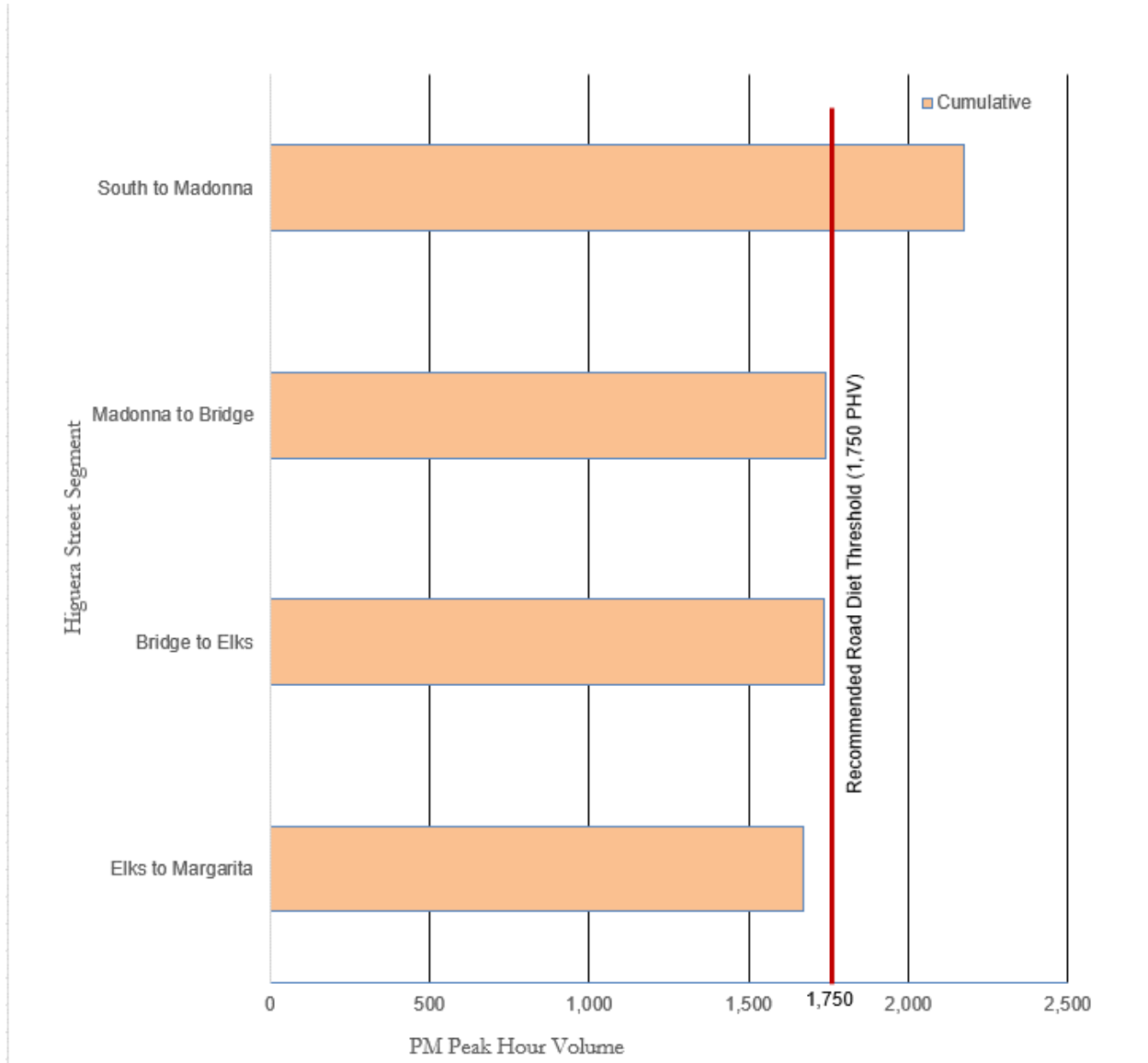
Exhibit 3: Near Term PM Peak Hour Volumes



The Cumulative forecasts reflect buildout of City General Plan and regional land uses and include the Prado Road overcrossing of US 101 (with northbound ramp access) as well as the extension of Prado Road to Broad Street. These new connections will shift travel patterns in the City and reduce travel demand along Higuera Street between Madonna Road and Prado Road. The Prado Road bridge west of Higuera Street is assumed to be widened in this scenario, along with implementation of a protected intersection at the Prado Road/Higuera Street intersection.

Exhibit 4 shows planning-level peak hour volume forecasts along the corridor between Higuera Street/South Street (#3) and Higuera Street/Margarita Avenue (#7) under Cumulative conditions compared to the road diet threshold. The segment from South Street to Madonna Road is expected to carry more than 1,750 vehicles per hour, but volumes drop below the threshold between Madonna Road and Margarita Avenue. This indicates that the road diet is expected to perform acceptably through buildout of the General Plan.

Exhibit 4: Cumulative PM Peak Hour Volumes between South Street and Margarita Avenue



Project Analysis

The proposed project would affect vehicular capacity at the study intersections on Higuera Street from Madonna Road to north of Margarita Avenue where the road diet begins as well as the Higuera Street/Los Osos Valley Road (#12) intersection. Accordingly, the project analysis and evaluation of future conditions is limited to the locations where vehicular capacity will change (geometric changes or modified signal phasing). The remainder of the corridor has been studied extensively as a part of the City’s Circulation Element and multiple transportation impact studies.

Table 4 shows the peak hour auto level of service (LOS) at the study intersections under Existing, Near Term, and Cumulative Conditions. The Near Term and Cumulative traffic volumes are shown in **Attachment A**. The Synchro output sheets are included in **Attachment C**.

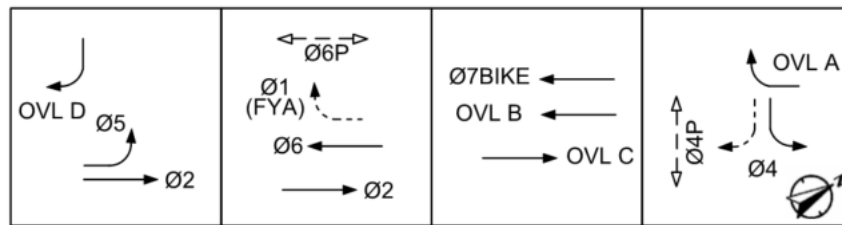
Table 4: Existing, Near Term, and Cumulative Intersection Levels of Service

Existing, Near Term, and Cumulative Intersection Levels of Service													
Intersection	Peak Hour	Existing		Existing + Project		Near Term		Near Term + Project		Cumulative		Cumulative + Project	
		Delay ¹	LOS	Delay ¹	LOS	Delay ¹	LOS	Delay ¹	LOS	Delay ¹	LOS	Delay ¹	LOS
4. Higuera St/ Madonna Rd	AM	19.6	B	33.5	C	25.1	C	46.3	D	25.6	C	46.5	D
	PM	25.4	C	42.3	D	32.9	C	51.9	D	33.2	C	52.1	D
5. Higuera St/ Bridge St ²	AM	11.5	B	12.0	B	15.2	C	15.0	C	20.5	C	17.7	C
	PM	15.7	C	15.4	C	21.8	C	19.9	C	26.6	D	21.4	C
6. Higuera St/ Elks Ln ²	AM	17.3	C	8.9	A	22.6	C	10.4	B	25.0	D	10.7	B
	PM	59.5	F	16.8	B	83.9	F	18.4	B	120.3	F	19.0	B
12. Higuera St/ LOVR	AM	17.2	B	30.7	C	27.7	C	36.1	D	21.5	C	35.9	D
	PM	52.7	D	54.9	D	55.0	E	61.1	E	55.0	E	61.1	E
13. Madonna Rd/ US 101 SB	AM	15.4	B	30.5	C	21.5	C	36.2	D	21.9	C	36.9	D
	PM	25.5	C	36.7	D	26.5	C	39.0	D	28.4	C	42.9	D
14. Madonna Rd/ US 101 NB	AM	9.4	A	24.9	C	10.3	B	25.5	C	10.7	B	25.6	C
	PM	21.5	C	28.7	C	25.3	C	36.9	D	26.1	C	37.4	D
15. Higuera St/ Chumash Dr ²	AM	12.9	B	15.7	C	15.0	C	19.3	C	15.8	C	20.8	C
	PM	14.5	B	17.2	C	15.4	C	18.4	C	16.2	C	19.7	C

1. HCM 6th or HCM 2000 average control delay in seconds per vehicle. For side-street-stop controlled intersections, the worst approach's delay is reported. A 500' initial southbound queue was added to #12 for the HCM 6th Edition methodology based on intersection observations. The addition of a bicycle phase requires the use of HCM 2000 and the initial queue is not used. Therefore, the delay in Plus Project columns may be longer than shown in the table.
Note: Unacceptable operations at City intersections shown in bold text.

All study locations operate acceptably at LOS D or better under all scenarios except Higuera Street/Los Osos Valley Road (#12) during the PM peak hour under Near Term and Cumulative Conditions with the project and the addition of the southbound bicycle signal phase, northbound protected left turn phase, eastbound right turn overlap phase, LPI, time of day plans, and no right turn on red (RTOR) for southbound and eastbound. The proposed Higuera Street/Los Osos Valley Road (#12) project signal phasing is shown in **Exhibit 5**.

Exhibit 5: Higuera Street/Los Osos Valley Road (#12) Proposed Signal Phasing

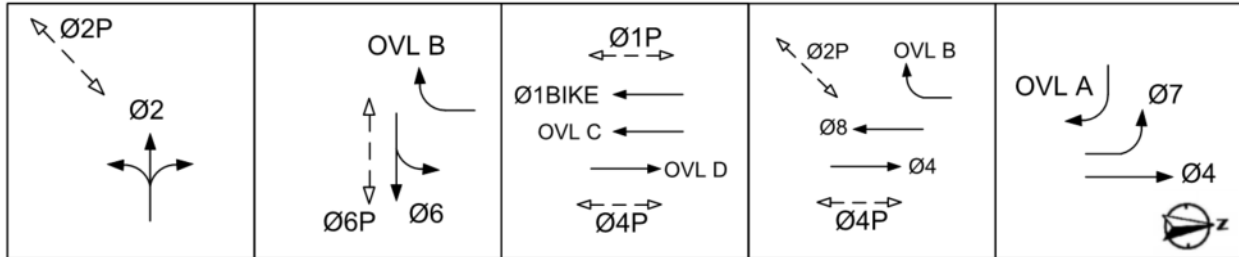


Note: Phases 2 and 6 are Higuera Street and Phase 4 is LOVR.

With the northbound protected left turn phase, eastbound right turn overlap phase, LPI, time of day plans, and no bike phase, the intersection would operate at LOS C (26.3 seconds of average delay) and D (54.9 seconds of average delay) during the AM and PM peak hour under Cumulative Conditions with the project, respectively. With a bicycle and pedestrian phase, the intersection would operate at LOS F during the PM peak hour. Note that the analysis software reports conditions with the bicycle and pedestrian phases actuated (e.g. the worst case); when not actuated the operations would be better.

Higuera Street/Madonna Road (#4) operates acceptably with the addition of a southbound bicycle and pedestrian phase, restriction of southbound left turns, conversion of a northbound through lane to a left turn lane, LPI, time of day plans, and no RTOR for southbound, eastbound, and northbound. A traffic signal with a northbound protected left turn vehicle phase and bicycle refuge for northbound left turning cyclists would operate acceptably at Higuera Street/Elks Lane (#6). The Higuera Street/Los Osos Valley Road (#12) project signal phasing is shown in **Exhibit 6**.

Exhibit 6: Higuera Street/Madonna Road (#4) Proposed Signal Phasing



Note: Phase 2 is the commercial center, Phases 4 and 8 are Higuera Street, and Phase 6 is Madonna Road.

The Higuera Street/Bridge Street (#5) and Higuera Street/Chumash Drive (#15) intersections would also operate acceptably with the road diet.

The existing signal timing on the Madonna Road Overpass is coordinated during the PM peak hour and the cycle length does not accommodate the southbound pedestrian movement at Madonna Road/US 101 Southbound Ramps (#13). The southbound pedestrian flashing don't walk time continues with eastbound left and northbound right turning vehicles prior to eastbound left turning vehicles which cannot be fully modeled in Synchro. The analysis assumes signal timing updates at the intersections consistent with the CAMUTCD as well as LPI, and no RTOR for the eastbound and westbound Madonna Road phases as well as the Madonna Inn driveway. Note that with the existing signal timing and removal of a westbound through lane at Madonna Road/US 101 Southbound Ramps (#13), the intersection delay would increase by less than one second over the no project conditions.

Table 5 and **Table 6** summarize the vehicular queuing for key movements at City and Caltrans intersections.

Table 5: Existing, Near Term, and Cumulative Intersection Queues (City)

Existing, Near Term, and Cumulative Intersection Queues (City) ¹										
Intersection	Movement	Storage Length ²	Peak Hour	Existing		Near Term		Cumulative		
				No Project	Plus Project	No Project	Plus Project	No Project	Plus Project	No Bike Phase
4. Higuera St/ Madonna Rd	EBL	850	AM	231	278	#357	382	#357	382	-
			PM	#314	380	#408	#484	#408	#484	-
	EBR	140	AM	33	318	125	#749	131	#749	-
			PM	47	347	61	347	61	347	-
	NBL	160	AM	124	94	181	136	181	136	-
			PM	207	140	#397	#246	#397	#246	-
NBT	-	AM	72	244	110	394	110	394	-	
		PM	112	303	168	470	185	532	-	
SBT	220 (375)	AM	135	171	196	243	219	271	-	
		PM	196	202	240	238	#267	263	-	
SBR	330 (375)	AM	106	97	172	202	172	202	-	
		PM	230	228	281	290	281	302	-	
5. Higuera St/ Bridge St	WB	-	AM	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	-
			PM	vehicle	vehicle	vehicle	vehicle	vehicle	vehicle	-
6. Higuera St/ Elks Ln	EBL/R	-	AM	8	40	10	46	13	47	-
			PM	110	168	138	169	168	170	-
	NBL	175	AM	0	6	0	16	0	17	-
			PM	0	22	0	30	3	34	-
SBT	-	AM	0	425	0	588	0	654	-	
		PM	0	668	0	754	0	852	-	
SBR	50	AM	0	26	0	26	0	26	-	
		PM	0	39	0	40	0	41	-	
12. Higuera St/ LOVR	EBL	-	AM	#369	467	#485	610	#442	556	436
			PM	#463	#584	#496	#585	#496	#585	#550
	EBR	100	AM	102	128	111	127	131	157	53
			PM	166	242	194	274	194	274	174
	NBL	200	AM	58	185	78	257	78	257	191
			PM	80	#292	#107	#333	#107	#333	#368
SBT	-	AM	159	280	173	321	195	363	285	
		PM	387	613	455	#734	455	#734	683	
SBR	-	AM	92	152	126	214	94	159	141	
		PM	415	#713	409	#719	409	#719	611	
15. Higuera St/ Chumash Dr	WB	-	AM	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	-
			PM	vehicle	vehicle	vehicle	vehicle	vehicle	vehicle	-

1. Queue length that would not be exceeded 95 percent of the time. **Bold** indicates queue length longer than storage or block length. # indicates that 95th percentile volume exceeds capacity, queue may be longer. m indicates volume for 95th percentile queue is metered by upstream signal.

2. Existing storage length (Project storage length) in feet.

Table 6: Existing, Near Term, and Cumulative Intersection Queues (Caltrans)

Existing, Near Term, and Cumulative Intersection Queues (Caltrans) ¹									
Intersection	Movement	Storage Length ²	Peak Hour	Existing		Near Term		Cumulative	
				No Project	Plus Project	No Project	Plus Project	No Project	Plus Project
13. Madonna Rd/ US 101 SB	WBL	250 (235)	AM	119	157	163	#222	175	#227
			PM	191	#246	m168	m#186	m159	m154
	WBT	950	AM	109	290	138	366	153	366
			PM	165	418	197	#554	m194	m#500
NBL	700	AM	162	205	197	227	256	#300	
		PM	#302	#387	#334	#426	#389	#489	
NBR	240	AM	137	56	235	119	230	119	
		PM	48	30	67	32	67	32	
14. Madonna Rd/ US 101 NB	EBL	410 & 900	AM	187	157	#252	#305	#252	#305
			PM	257	#206	#321	#406	#321	m#392
	EBT	950	AM	193	61	295	541	295	541
			PM	196	31	254	46	253	46
	WBT	850	AM	231	276	306	363	332	397
PM			#482	479	#651	#683	#708	#759	
NBL	170	AM	104	146	109	147	109	147	
		PM	138	168	168	206	168	206	
NBT/R	-	AM	66	70	110	136	110	136	
		PM	45	51	46	54	46	54	

1. Queue length that would not be exceeded 95 percent of the time. **Bold** indicates queue length longer than storage or block length. # indicates that 95th percentile volume exceeds capacity, queue may be longer. m indicates volume for 95th percentile queue is metered by upstream signal.

2. Existing storage length (Project storage length) in feet.

Queue deficiencies are noted at the following locations:

- Higuera Street/Madonna Road (#4): The eastbound right and northbound left turn queue exceeds the storage length during one or more peak hours with the project. The northbound queue would also reach Bridge Street during one or more peak hours with the project. Implementation of the project would substantially shorten the forecast northbound left turn queue by adding an additional lane. We recommend installing “KEEP CLEAR ” pavement markings at Bridge Street and extending one of the northbound left turn lanes to Bridge Street.
- Higuera Street/Los Osos Valley Road (#12): The eastbound right and northbound left turn queue exceeds the storage length during one or more peak hours with or without the bike phase and the addition of a northbound protected left turn phase, eastbound right turn overlap phase, LPI, and time of day plans. We recommend restriping the northbound left turn lane storage to 375 feet or as feasible within the existing roadway width.
- Madonna Road/US 101 Southbound Ramps (#13): The westbound left turn queue exceeds the storage length during the PM peak hour under Existing Conditions with the project. We recommend the project reduce the westbound ten-foot bike lane width to increase the westbound left turn lane storage to the existing length or longer as feasible.
- Madonna Road/US 101 Northbound Ramps (#14): The northbound left turn queue exceeds the storage length during the PM peak hour under Near Term and Cumulative Conditions with the

project. However, the queue can be accommodated in the bay taper and would not likely block the adjacent lane.

CONCLUSIONS

The project will substantially improve conditions for cyclists and pedestrians by improving delineation, increasing separation from vehicular traffic, improving traffic signal timing, and implementing a road diet on a portion of the corridor, all measures that have been proven to improve cyclist comfort and reduce frequency and severity of collisions. Vehicular queueing and delay will increase along the constrained portions of the corridor.

ATTACHMENTS

- A. Traffic Volume Figures
- B. Traffic Count Data
- C. Synchro Output Sheets

REFERENCES

- City of San Luis Obispo. 2014. Circulation Element of the General Plan.
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