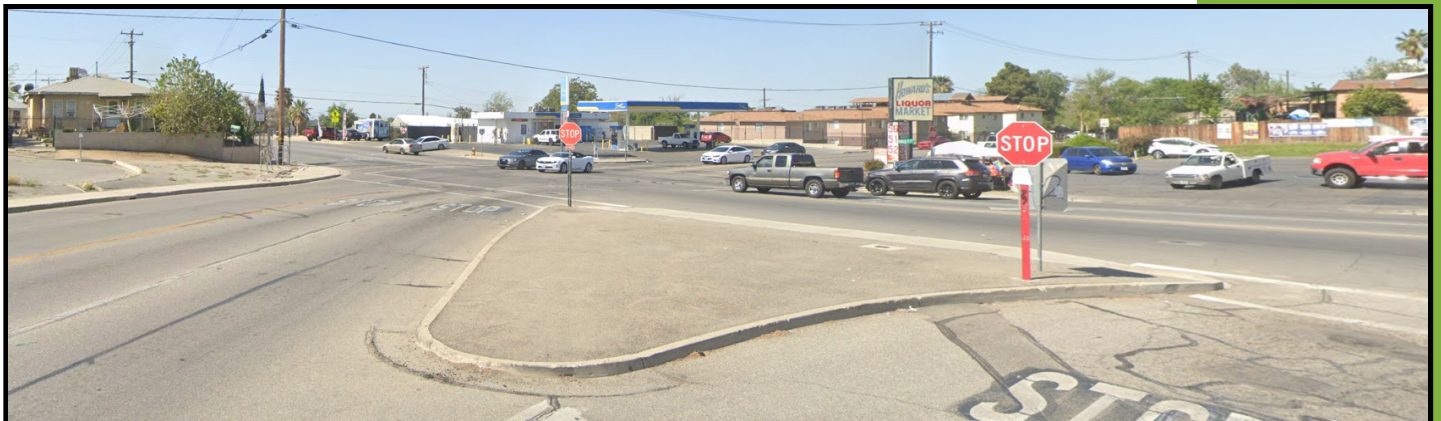




## **CMAQ APPLICATION: Roundabout**

### **Bernard Street and Haley Street (East Bakersfield)**

Project Limits: Intersection of Bernard  
Street and Haley Street



**KERN COUNCIL OF GOVERNMENTS**  
**Congestion Mitigation and Air Quality (CMAQ) Program**  
**PROJECT APPLICATION – Due Thursday, July 17, 2025**

\*Please note this is a PDF fillable form so responses may be typed. Items 1, 2, 7, and 22 are drop downs. Totals in item 6 will automatically calculate.

- (1) Is the project included in a local agency-adopted resolution supporting the project? YES NO
- (2) Does the proposed project meet basic eligibility requirements? YES NO
- (3) Project background and justification: Explain the project in terms of the existing infrastructure, its impact for service, safety or any other issue that is relevant to the project (attach to application). If the project scope relates to fueling infrastructure please provide a 3-year fleet conversion plan.
- (4) Lead Agency: \_\_\_\_\_
- (5) Project description [(Location:) + (Limits) + (;) + (Improvement/Activity)]  
\_\_\_\_\_  
\_\_\_\_\_

(6)	Funding Type	PE	R/W	Const.	Total
	Local	\$ _____	\$ _____	\$ _____	\$ _____
	Local	\$ _____	\$ _____	\$ _____	\$ _____
	State	\$ _____	\$ _____	\$ _____	\$ _____
	Federal	\$ _____	\$ _____	\$ _____	\$ _____
	Total	\$ _____	\$ _____	\$ _____	\$ _____

- (7) Programming Year by Phase: PE: \_\_\_\_\_ R/W: \_\_\_\_\_ Const: \_\_\_\_\_
- (8) VMT Reduction (annual miles): \_\_\_\_\_
- (9) VOC Reduction (kg/day): \_\_\_\_\_ Additional documentation required. See instructions.
- (10) NOx Reduction (kg/day): \_\_\_\_\_ Additional documentation required. See instructions.
- (11) PM<sub>10</sub> Reduction (kg/day): \_\_\_\_\_ Additional documentation required. See instructions.
- (12) PM<sub>2.5</sub> Reduction (Kg/day): \_\_\_\_\_ Additional documentation required. See instructions.
- (13) CO Reduction (kg/day): \_\_\_\_\_ Additional documentation required. See instructions.
- (14) Cost-Effectiveness (\$/lb): \_\_\_\_\_ Additional documentation required. See instructions.
- (15) Livability and Safety: Describe how project provides the six benefits; limit to half page per benefit.
- (16) Hwy Peak Period LOS Before Project (AM/PM average): \_\_\_\_\_
- (17) Hwy Peak period LOS After Project (AM/PM average): \_\_\_\_\_
- (18) Bikeway Peak Period LOS Before Project (AM/PM average): \_\_\_\_\_
- (19) Bikeway Peak period LOS After Project (AM/PM average): \_\_\_\_\_
- (20) Pedestrian Peak period LOS Before Project (AM/PM average): \_\_\_\_\_
- (21) Pedestrian Peak period LOS After Project (AM/PM average): \_\_\_\_\_
- (22) Is the project identified as a RACM/BACM? YES NO

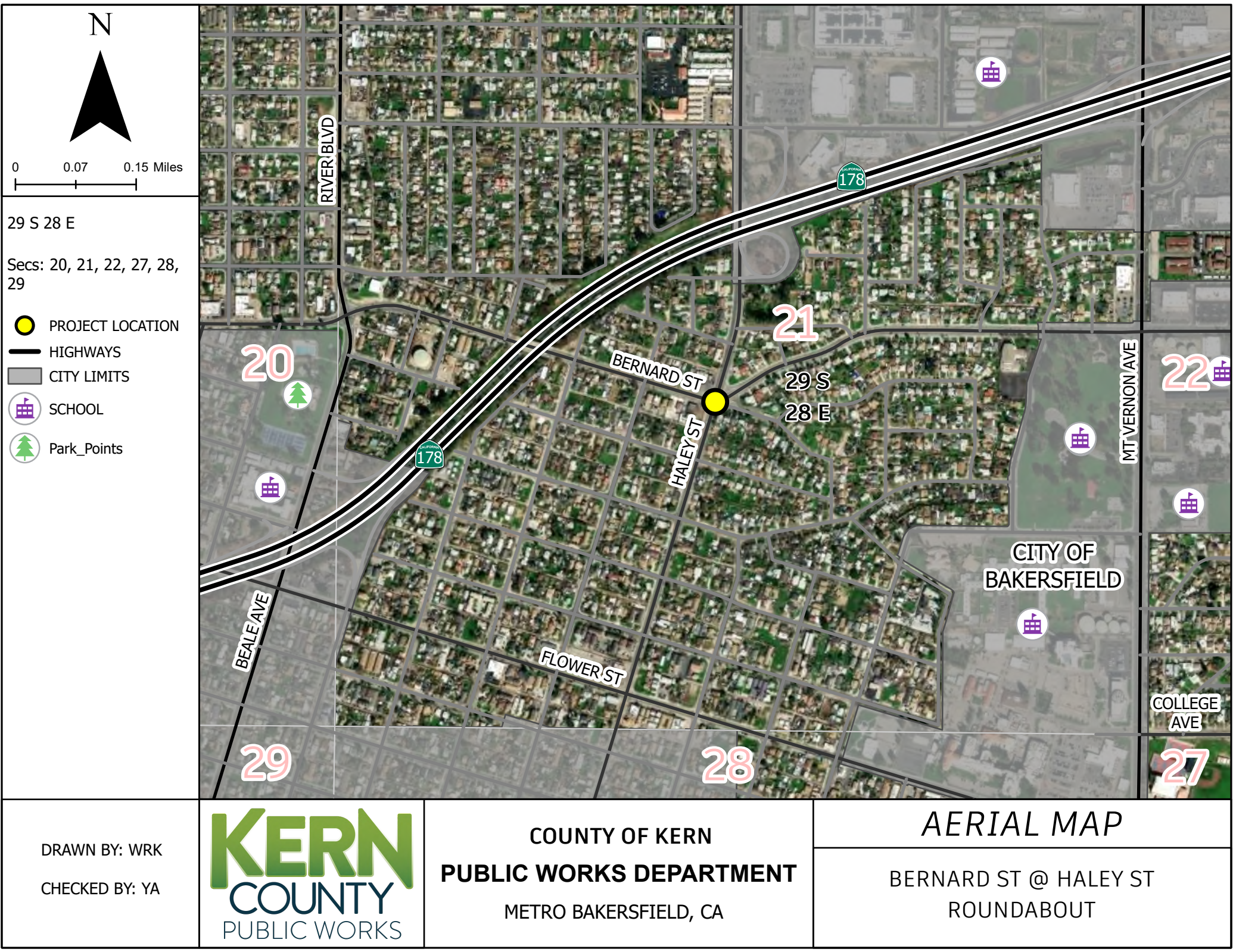
Application completed by: _____	Date Completed: _____
E-mail: _____	Phone Number: _____
Agency: _____	
Address: _____	

Send completed application electronically on a flash drive with transmittal letter on agency letterhead to:

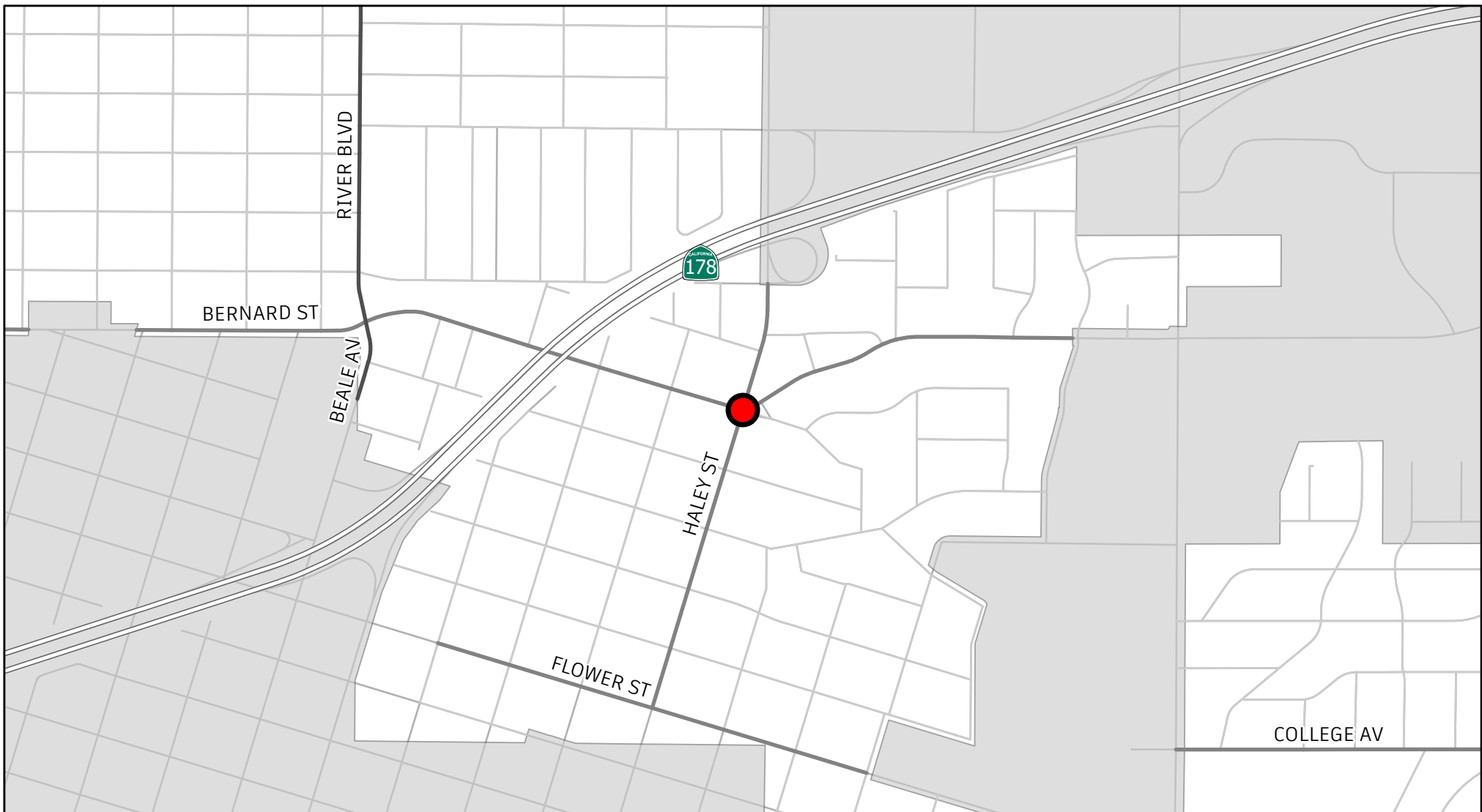
Attn: Ceasar Valle ❖ Kern Council of Governments, 1401 19th Street, Suite 300, Bakersfield, CA 93301

OR send Digitally via [Dropbox, click here.](#)









### VICINITY MAP

**BERNARD ST @ HALEY ST  
ROUNDAABOUT**

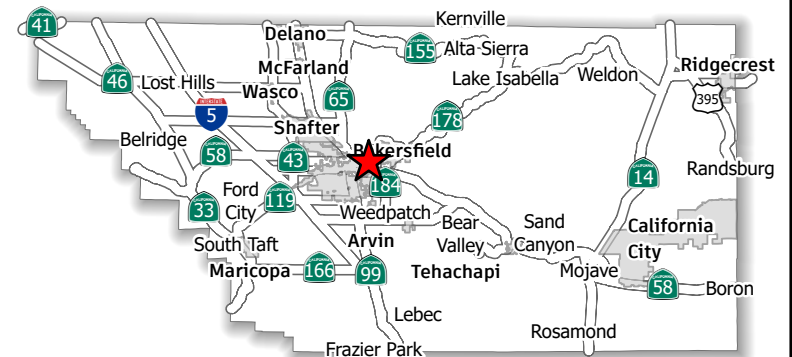
COUNTY OF KERN  
DEPARTMENT OF PUBLIC WORKS

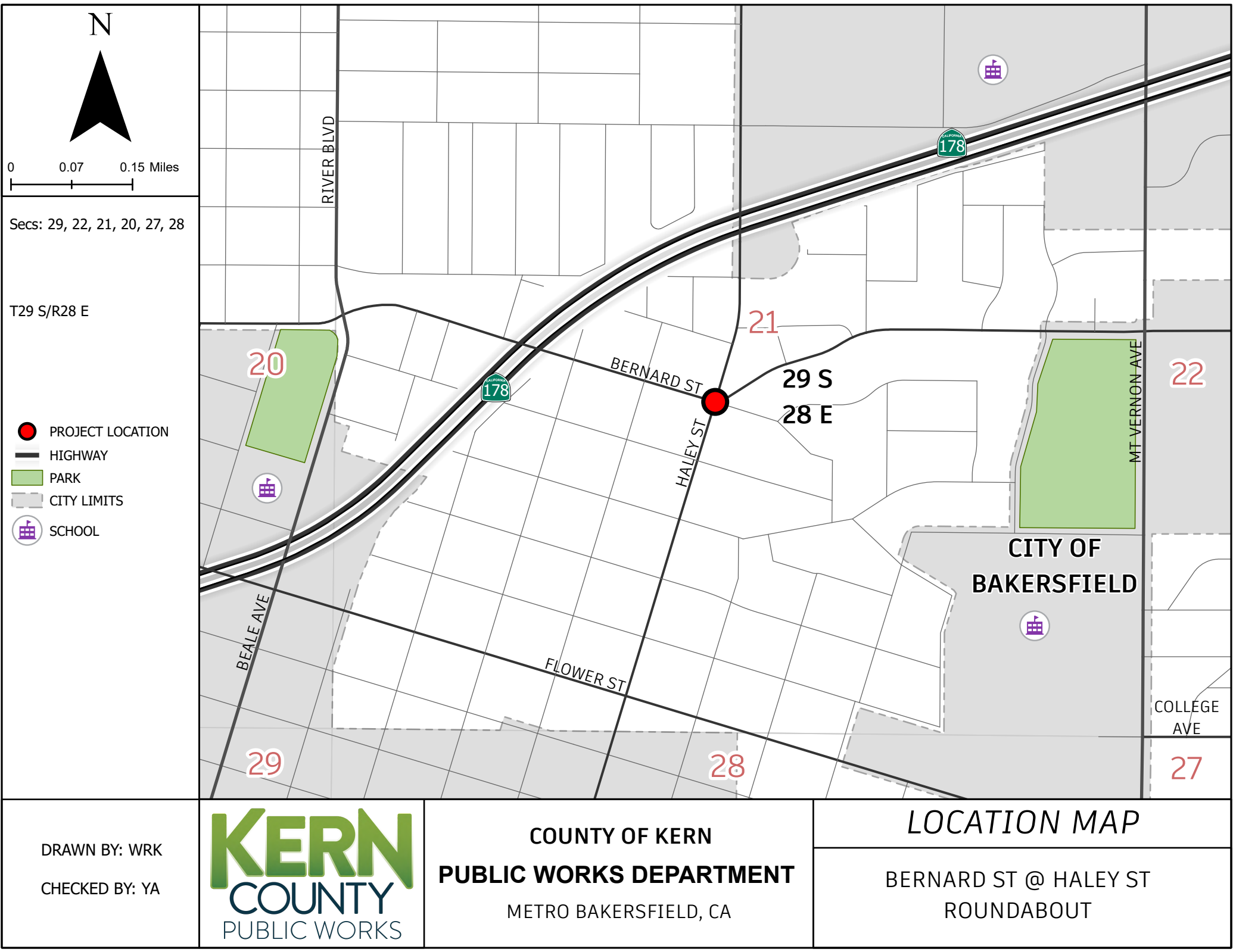
### **Legend**

- PROJECT LOCATION
- HIGHWAYS
- CITY LIMITS

0 0.25 0.5  
Miles

Map by: Kilmerw  
Printed: 4/23/2025





DRAWN BY: WRK

CHECKED BY: YA

KERN

COUNTY

PUBLIC WORKS

COUNTY OF KERN

PUBLIC WORKS DEPARTMENT

METRO BAKERSFIELD, CA

LOCATION MAP

BERNARD ST @ HALEY ST  
ROUNDAABOUT

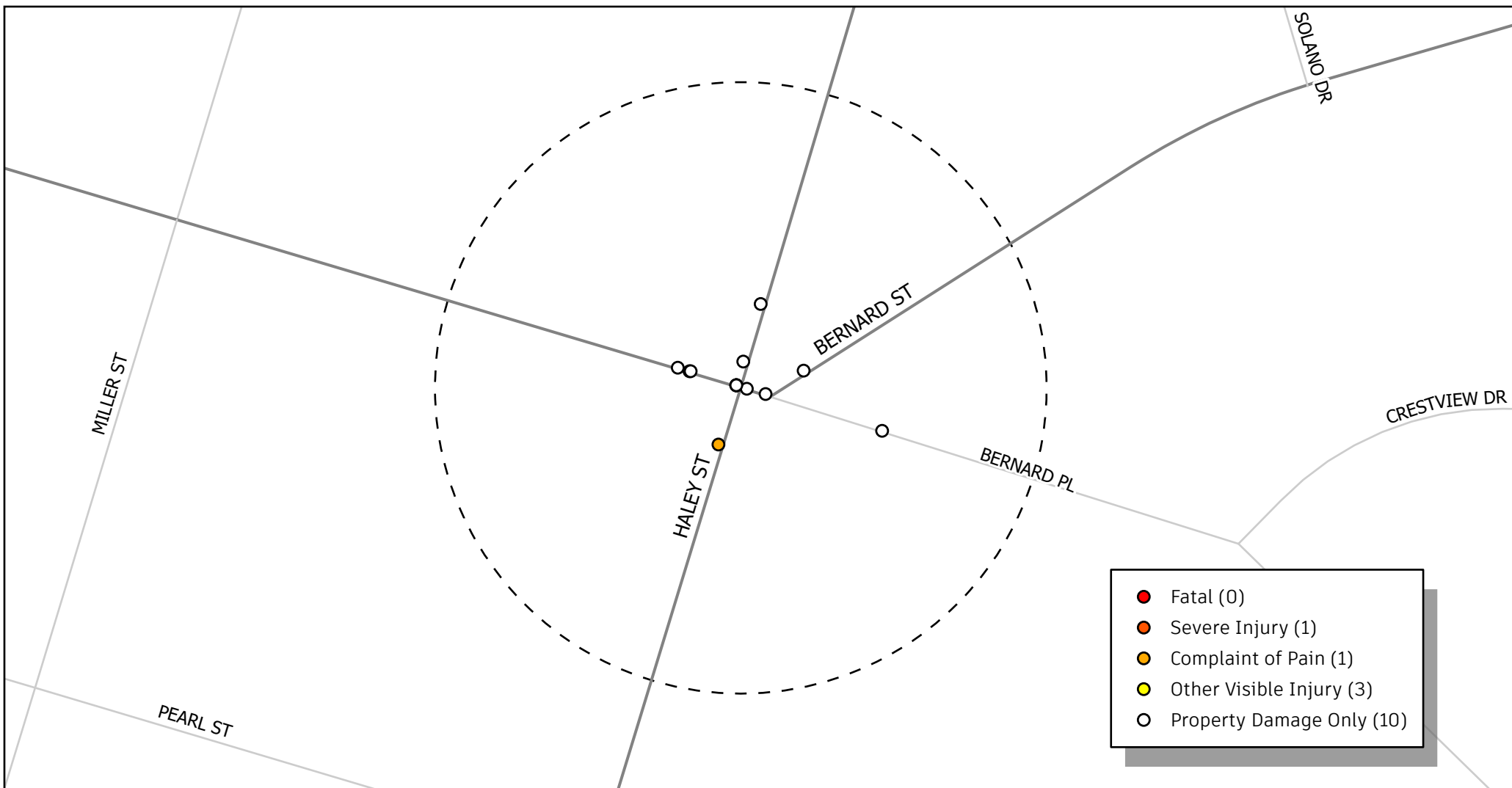
N

## TRAFFIC COLLISION MAP

## BERNARD ST @ HALEY ST

JANUARY 2022 - DECEMBER 2024

LOCATION: METRO BAKERSFIELD



[ - ] 250ft Buffer

**Total Collisions: 15****Fatalities: 0****Injuries: 5****Collision Rate (c/mve)**

Statewide Average: 0.21

Before Rate: 5.95

After Rate: 0.21

**Fatality Rate (c/mve)**

Statewide Average: 0.005

Before Rate: 0.0

After Rate: 0.005

$$\text{Collision Rate} = \frac{(\text{Number of Collisions} \times 1 \text{ Million})}{(\text{ADT} \times 365 \text{ Days Per Year} \times \text{Segment Length} \times \text{Number of Years})}$$

C/MVE: Collisions per mile vehicles  
entering intersection

ADT: Average Daily Traffic Volume

0 0.03 0.05  
Miles

**KERN**  
COUNTY  
PUBLIC WORKS

**Collision Data Source:**

California Highway Patrol (CHP), 2022

California State Transportation Agency (CalSTA) Department of Transportation, 2020

Collision Data on California State Highways (road miles, travel, collisions, collision rates). 2022

Federal Highway Administration (FHWA) U.S. Department of Transportation, (2010)

Roadway Safety Information Analysis: A Manual for Local Rural Road Owners. 2022



## **PROJECT BACKGROUND**

1. Justitification
2. Livability
3. Safety
  - A. Collision Maps
  - B. Collision Rates

CMAQ Roundabout Project:  
Bernard Street and Haley Street  
(East Bakersfield)

Project Limits: Intersection of Bernard Street and Haley Street

# Project Description & Justification

## Project Description

The proposed project would construct a roundabout, high visibility crosswalks, and ancillary facilities necessary for the proper construction and operation of these facilities according to Kern County and Caltrans, and the Americans with Disabilities Act (ADA) design standards. ADA compliant facilities including curbs, gutters, curb-ramps, and sidewalks necessary to ensure the accessibility of the intersection by disabled pedestrians.

## Project Justification

The intersection of Bernard Street and Haley Street is located in an unincorporated area of east Bakersfield. This is a non-traditional 4-way intersection where 2 two-lane collector roads are reduced down to one lane at this skewed intersection. It is complicated by an adjacent residential road which will result in a 5-legged roundabout to make this an efficient facility. The intersection has a Level of Service (LOS) of "C" that once improved will have a LOS of "A." Per the last traffic study conducted, drivers at this intersection experience 20 seconds of delay from congestion. After the project, the average delay would decrease by 60% to 8 seconds, saving 12 seconds each time motorists cross the intersection. The congestion is a result of 16,500 vehicle trips each day (per the last study.) After the project, drivers could expect to save a total of more than 20,075 vehicle hours a year and over \$280,000 annually from reduced delay costs.

The San Joaquin Valley Air Pollution Control District (SJVAPCD) is currently in non-attainment for the 8-hour Ozone Standard (cause by volatile organic compounds (VOC) and nitrogen oxide ( $\text{NO}_x$ )), particulate matter smaller than 2.5 microns ( $\text{PM}_{2.5}$ ) emissions, and  $\text{PM}_{10}$  emissions under state and federal clean air guidelines. Additionally, the Bakersfield metropolitan area is also under a Carbon Monoxide maintenance plan. these pollutants have been linked to premature death, respiratory and cardiovascular diseases, lost work days, school absences, and reduced activity, all of which translates into increased health costs. the anticipated reduction in emissions will help SJVAPCD meet its air quality goals by reducing 1,600 pounds per year of these pollutants, the most significant. Attainment of California's emissions standards would prevent up to around 9,000 premature deaths annually statewide, per California Air Resources Board, 2010 study.

Roundabouts are a common form of intersection control used throughout the world and are increasingly being used now in the U.S. Roundabouts are safer than signalized intersections due to traffic calming which requires drivers to slow down to a safer speed when approaching. This reduces crash severity and limits crash types to side impacts only. The largest benefit is that the configuration of roundabouts eliminate head-on crashes and t-collisions that are more likely to cause fatalities. In addition, they are the largest contributor to the reduction of greenhouse gases by reducing vehicle idling time. This project will reduce 0.108 kg/day of VOC which translates to over 20,000 lbs (788 kg) over the next 20 years for ozone reduction.



Intersection of Bernard St and Haley St, Kern County



# Livability and Safety

**1. Will enhance or reduce the average cost of user mobility through the creation of more convenient transportation options for travelers?**

Yes, the project will reduce the average cost of user mobility by creating a more convenient, cost effective, option for travelers through decreased travel time. The level of service for the intersection is "C" resulting in an average delay of 20 seconds per vehicle (per the last traffic study conducted). The proposed project would improve that level of service to an "A," decreasing the average delay to 8 seconds. Per the last traffic study, when the intersection serviced 16,500 vehicles, a 12 second improvement could result in a cumulative reduction of 20,000 hours per year. The USDOT's 2016 Value of Travel Time guidance estimates an average value of \$14.10 per hour for all travelers. As a result, this delay costs the community over \$280,000 per year and more than \$5.6 million over the next 20 years.

**2. Will improve existing transportation choices by enhancing points of modal connectivity, increasing the number of modes accommodated on existing assets, or reducing congestion on existing modal assets?**

Yes, the project will improve existing transportation choices by increasing the number of modes accommodated and reducing congestion of Bernard Street and Haley Street. The installation of pedestrian refuges, high visibility crosswalks, and intersection lighting will now accommodate both walking and biking modes of transportation, in addition to the existing vehicle traffic. It will lower the speed of cars crossing through the intersection and remove left turn conflicts, increasing safety for all travelers. The project will significantly reduce the congestion of the existing modal assets by installing a roundabout. Currently the Level of Service for this intersection is a "C" with a 20 second average delay. The project can reduce the delay to a new average of 8 seconds, improving the Level of Service to an "A."

**3. Will improve travel between residential areas and commercial centers and jobs?**

Yes, residential areas nearby will be better connected with SR178, surrounding commercial centers, and Bakersfield College. Haley Street provides direct connection to the 178, which connects the neighborhood to downtown Bakersfield, SR99, and beyond. The greatest improvement to travel for this intersection's over 16,500 vehicle trips (per the last study) is the cost savings resulting from decreased congestion. The improvement from a LOS "C" to a LOS "A" will result in an average of 12 seconds less delay at this intersection per trip. The cumulative time savings total 20,000 vehicle hours per year.

**4. Will improve accessibility and transportation services for economically disadvantaged populations, non-drivers, senior citizens, and persons with disabilities, or make goods, commodities, and services more readily available to these groups. The two Safety benefits are:**

Yes, the project will improve accessibility and transportation services for economically disadvantaged populations, non-drivers, and people with disabilities. The project is located within, and predominantly serves Census tract 6029001300 which is at the 93rd percentile of the most environmentally burdened and economically disadvantaged communities, per CalEnviroScreen 4.0. The project will directly increase accessibility to non-drivers, senior citizens, and persons with disabilities by installing pedestrian facilities that meet the most recent Americans with Disabilities Act (ADA) construction standards. Improved efficiency of this intersection will make goods and services more readily available to these groups.

**5. Is the existing Accident Rate higher than the average rate for a similar facility, and does the project reduce the Accident Rate to the average rate or lower? Yes or No and if yes, provide rates and supporting documentation:**

Yes, the existing Collision/Accident Rate is higher than the statewide average rate. The After Collision/Accident Rate will be equal to or lower than the statewide average rate (See Collision Map).

**6. Is the existing Fatality Rate higher than the average rate for a similar facility, and does the project reduce the Fatality Rate to the average rate or lower? Yes or No and if yes, provide rates and supporting documentation.**

No, the existing fatality rate is not higher than the state average. The project will keep the fatality rate 0.00, and equal to the state average rate. (See Collision Map).



# **EMISSIONS BENEFIT & COST EFFECTIVENESS**

CMAQ Roundabout Project:  
Bernard Street and Haley Street  
(East Bakersfield)

Project Limits: Intersection of Bernard Street and Haley Street



## Memorandum

TO: Yolanda Alcantar  
County of Kern Public Works Department  
2700 M Street, Suite 400  
Bakersfield, CA 93301

FROM: Anders Sutherland, Environmental Scientist  
Terry A. Hayes Associates Inc.  
3535 Hayden Avenue, Suite 350  
Culver City, CA 90232

DATE: August 21, 2017

RE: **Emissions Reductions from Roundabout Implementation –  
Intersection of Bernard Street and Haley Street in Bakersfield, CA**

Terry A. Hayes Associates Inc. (TAHA) prepared this technical memorandum for SWCA Environmental Consultants (SWCA) to assess the change in daily air pollutant emissions that would result from implementation of a proposed roundabout configuration at the intersection of Bernard Street and Haley Street in Bakersfield, CA (proposed project). The assessment was completed to support the demonstration of cost-effectiveness in obtaining approval of Congestion Mitigation and Air Quality Improvement (CMAQ) funding from the Federal Highway Administration (FHWA).

The FHWA CMAQ guidance does not address the quantification of emissions reductions and associated cost benefits from implementation of roundabouts. The following discussion describes the source of traffic data relied upon to complete the emissions reductions analysis and the methodology employed to calculate daily emissions reductions, and presents the results of the assessment. The objective of the analysis was to compare daily vehicular air pollutant emissions under the existing intersection configuration to daily vehicular air pollutant emissions with implementation of a roundabout based on the peak hour traffic volumes and average vehicle delay.

### Traffic Data

Daily estimates of air pollutant emissions from vehicles traveling through the intersection of Bernard Street and Haley Street were calculated using peak hour traffic volumes and delay data generated by Omni-Means.<sup>1</sup> The *Traffic Operations Analysis* evaluated three peak-hour periods of the day: morning (AM), midday (MD), and evening (PM). Metro Traffic Data, Inc. collected traffic counts over two hours in the AM period, two and a half hours during the MD period, and

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<sup>1</sup>Omni-Means, *Kern County CMAQ Applications – Traffic Operations Analysis*, July 20, 2017.



two hours during the PM period to establish existing conditions in the all-way stop control (AWSC) intersection. The collected data were analyzed by Omni-Means using the 2010 Highway Capacity Manual (HCM) methodologies for the AWSC configuration and the roundabout configuration. Omni-Means estimated existing approaching traffic volumes from each direction, turning movements, heavy truck percentages, and average delay during a single peak hour in the AM, MD, and PM periods for the existing AWSC configuration and the proposed roundabout. A summary of the Omni-Means results is presented in **Table 1**.

<b>TABLE 1: SUMMARY OF OMNI-MEANS HCM TRAFFIC DATA – BERNARD STREET &amp; HALEY STREET</b>				
<b>Configuration</b>	<b>Period</b>	<b>Average Delay (sec/veh)</b>	<b>Peak Hour Volume (veh/hr)</b>	<b>Heavy Vehicles (%)</b>
AWSC	AM	15.6	1,081	2.7%
	MD	17.3	1,233	1.9%
	PM	20.4	1,407	0.6%
Roundabout	AM	7.0	1,201	2.7%
	MD	7.9	1,340	1.9%
	PM	8.4	1,481	0.6%

**SOURCE:** Caltrans *Traffic Census Data*, 2017.

Each peak hour volume represents the maximum vehicles per hour during the associated time period that was generated by the 2010 HCM methodology. The increase in volumes during the peak hours under the roundabout configuration is attributed to the enhancement of flow and reduction of congestion resulting from implementation of the proposed project, as demonstrated by the substantial decrease in average delay per vehicle.

### Emissions Quantification

In the State of California, the California Air Resources Board (CARB) maintains a mobile source emissions inventory that includes air pollutant emissions factors for various vehicle types and processes associated with vehicle travel. The CMAQ methodology focuses on emissions of reactive organic gases (ROG)—also referred to as volatile organic compounds (VOC)—, oxides of nitrogen (NO<sub>x</sub>), and particulate matter less than 10 microns in diameter (PM<sub>10</sub>) for demonstrating emissions reductions and cost benefits. Emission factors for ROG, NO<sub>x</sub>, and PM<sub>10</sub> were obtained from the CARB EMFAC2014 mobile source emission inventory model, which is the most current version approved for use by the United States Environmental Protection Agency (USEPA). USEPA approval qualifies the model for use in federal applications such as CMAQ in lieu of the federal model for mobile source emissions (MOVES2014a) that is applicable to analysis in other states.

To characterize emissions from vehicle delay at the intersection of Bernard Street and Haley Street, emission factors were obtained for idling exhaust (VOC, NO<sub>x</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, and CO) and running loss (VOC) for non-trucks (passenger vehicles) and trucks (heavy vehicles) in Kern County for consistency with the HCM output. The emission factors produced by EMFAC2014 are expressed in terms of grams of pollutant emitted per hour of vehicle idling/running (g/hr). The traffic data generated by Omi-Means were used to calculate total daily delay during the three peak hours analyzed in the HCM model for each intersection configuration.

Weighted average emission factors were calculated using the heavy vehicle percentage in the HCM output. The HCM output only included analysis for three peak hours of the day, which is not reflective of total daily delay. To conservatively extrapolate the total daily delay at the intersection from the three peak hours (AM, MD, PM) combined, the sum of the peak hours delay was multiplied by a factor of two, representing that approximately half of the total daily delay would occur during these three hours. **Table 2** presents the results of the emissions analysis for the AWSC configuration and the proposed roundabout configuration. For the sake of clarity, values have been rounded to three decimal places and may not add precisely.

<b>TABLE 2: SUMMARY OF EMISSIONS COMPARISON BETWEEN AWSC AND ROUNDABOUT</b>			
<b>Pollutant</b>	<b>AWSC Emissions (kg/day)</b>	<b>Roundabout Emissions (kg/day)</b>	<b>Emissions Reduction (kg/day)</b>
VOC*	0.204	0.096	0.108
NO <sub>x</sub> *	2.492	1.170	1.321
PM <sub>10</sub> *	0.003	0.001	0.002
PM <sub>2.5</sub>	0.003	0.001	0.002
CO	1.056	0.496	0.560
<b>SOURCE:</b> TAHA, 2017. *Denotes pollutant included in cost-effectiveness calculations for CMAQ application.			

Detailed calculations describing the emissions estimation process can be found in the **Appendix**.

## Conclusions

Results of the mobile source emissions analysis determined that implementation of the proposed roundabout configuration at the intersection of Bernard Street and Haley street would result in daily emissions reductions of 0.108 kilograms ROG, 1.321 kilograms NO<sub>x</sub>, 0.002 kilograms PM<sub>10</sub>, 0.002 kilograms PM<sub>2.5</sub>, and 0.560 kilograms CO. The sum of daily emissions reductions for VOC, NO<sub>x</sub>, and PM<sub>10</sub> for the cost-effectiveness calculation is 1.43 kilograms per day. The mobile source emissions analysis concluded that implementation of the proposed roundabout configuration would reduce emissions in addition to enhancing vehicle flow and reducing congestion. The emissions reductions would contribute to the objective of improving regional air quality in pursuit of achieving attainment of the National Ambient Air Quality Standards (NAAQS), for which the San Joaquin Valley portion of Kern County is currently designated nonattainment of ozone (O<sub>3</sub>) and PM<sub>10</sub>.

## Calculate Cost-Effectiveness for Bernard Street and Haley Street

### Inputs to Calculate Cost-Effectiveness

Funding Dollars	<u>\$3,735,900</u>	CMAQ	<u>\$3,307,200</u>
Effectiveness Period (Life):	<u>20</u>		
Days of use/year	365		
Capital Recovery Factor			<u>0.07</u>

**Calculations:** See Attached Calculation Documents (Completed by Consultant)

### Annual Emission Reductions (ROG(VOC), NOx, and PM10) in lbs. per year

= [(0.50)\*(VMT)\*Before Speed Factor - After Speed Factor)]/454 grams per lb.

<b>ROG(VOC):</b>			<b>87</b>	<b>lbs. per year</b>
			<b>0.1080</b>	<b>Kilograms per Day</b>
<b>CO:</b>			<b>450</b>	<b>lbs. per year</b>
			<b>0.5600</b>	<b>Kilograms per Day</b>
<b>NOx:</b>			<b>1,061</b>	<b>lbs. per year</b>
			<b>1.3210</b>	<b>Kilograms per Day</b>
<b>PM2.5:</b>			<b>2</b>	<b>lbs. per year</b>
			<b>0.0020</b>	<b>Kilograms per Day</b>
<b>PM10:</b>	X	1.08 Conversion Factor	<b>0.0022</b>	<b>Kilograms per Day (PM10)</b>

**Capital Recovery Factor (CRF) =**  $\frac{(1+i)^n(i)}{(1+i)^n - 1}$  = 0.07 where n = project life (20 years)  
**(From Table 8)** and i = discount rate (3%)

### Cost-Effectiveness

**of Funding Dollars** = (CRF \* Funding) / (ROG + CO + NOx + PM2.5) = [ 0.07 \* 3,307,200 ] / 1,599  
= **\$144.79 per lb.**

### FOR CMAQ PROJECTS ONLY:

Once emissions reductions have been calculated, add them together and convert emissions reductions to kg/day

<b>Total Emission Reduction =</b>	<b>1,599</b>	<b>lbs. per year</b>	<b>Divide by</b>	<b>2.2 lbs./Kilogram</b>	<b>=</b>
				<b>Divide by 2.2 lbs./Kilogram</b>	
	<b>725</b>	<b>Kilograms per Year</b>			
				<b>Divide by 365 Days</b>	
	<b>1.99</b>	<b>Kilograms per Day</b>			





## **LEVEL OF SERVICE**

CMAQ Roundabout Project:  
Bernard Street and Haley Street  
(East Bakersfield)

Project Limits: Intersection of Bernard Street and Haley Street



**TABLE 1 (CON'T)**

Intersection		Future (2040) AM Peak Hour		Future (2040) MID Peak Hour		Future (2040) PM Peak Hour	
Bernard Street/Haley Street	Control Type	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
	AWSC	43.0	E	54.3	F	53.2	F
	Signal	9.3	A	11.8	B	12.5	B
	Roundabout	11.3	B	17.3	B	15.9	B

Notes: Existing traffic control at this intersection is AWSC; per County's request, the traffic signal assumes single lane approaches on Bernard Street.

### Cummings Valley Road/Bear Valley Road

Table 2 presents a summary of the existing and future LOS and delay for each intersection control type at the intersection of Cummings Valley Road/Bear Valley Road.

**TABLE 2**  
**EXISTING AND FUTURE LOS: CUMMINGS VALLEY ROAD/BEAR VALLEY ROAD**

Intersection		Existing AM Peak Hour		Existing MID Peak Hour		Existing PM Peak Hour	
Cummings Valley Road/Bear Valley Road	Control Type	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
	AWSC	13.1	B	41.7	E	13.4	B
	Signal	8.6	A	17.7	B	8.1	A
	Roundabout	5.8	A	6.6	A	7.1	A

Intersection		Future (2040) AM Peak Hour		Future (2040) MID Peak Hour		Future (2040) PM Peak Hour	
Cummings Valley Road/Bear Valley Road	Control Type	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
	AWSC	14.9	B	44.4	E	34.0	D
	Signal	9.0	A	13.9	B	11.3	B
	Roundabout	7.2	A	12.9	B	9.7	B

Note: Existing traffic control at this intersection is AWSC

## Attachments

### Bernard Street/Haley Street

- Existing AM, Midday and PM Peak Hour Traffic Counts & Lane Geometrics & Control
- Synchro Output Files (AWSC and signalized control)
- Sidra Output Files (Roundabout)

### Cumming Valley Road/Bear Valley Road

- Existing AM, Midday and PM Peak Hour Traffic Counts & Lane Geometrics & Control
- Synchro Output Files (AWSC and signalized control)
- Sidra Output Files (Roundabout)

### Kern COG

- Kern COG Regional Travel Demand Forecast Model Plots (2014 & 2040)



# Bernard and Haley Bicycle Level of Service (BLOS)

\*Based on PLOS and BLOS for signalized intersections methodology: Smart Growth for America  
<https://www.smartgrowthamerica.org/app/legacy/documents/cs/impl/nc-charlotte-pedbikelos.pdf>

## Bike Level of Service (BLOS)

Points	LOS
93+	A
74 - 92	B
55 - 73	C
37 - 54	D
19 - 36	E
0 - 18	F

Location: Bernard Street & Haley Street (AWCS)

## BEFORE BLOS

	EB Bernard	WB Bernard	NB Haley	SB Haley
Bike Travel Way & Speed of Adjacent Traffic	Shared Wide Curb Lane to Wide Curb Lane ≥ 40mph	Shared Wide Curb Lane to Wide Curb Lane ≥ 40mph	Shared Wide Curb Lane to Wide Curb Lane 30-35 mph	Shared Wide Curb Lane to Wide Curb Lane 30-35 mph
Score		30	30	50
Intersection Features				
Opposing Vehicular Left Turn	"Made on Green Ball only" equivalent	"Made on Green Ball only" equivalent	"Made on Green Ball only" equivalent	"Made on Green Ball only" equivalent
Score		0	0	0
Stop Bar Location	Shared stop bar - automobiles & bikes stop at common point	Shared stop bar - automobiles & bikes stop at common point	Shared stop bar - automobiles & bikes stop at common point	Shared stop bar - automobiles & bikes stop at common point
Score		0	0	0
Right Turning Traffic Conflict	Right Turn Conflict	Right Turn Conflict	Right Turn Conflict	Right Turn Conflict
Score		0	0	0
Shared Traffic Lane/Separate Right Turn Traffic Lane	No Separate Right Turn Lane (Bike in Shared Lane)	No bike lane (cyclist travels straight ahead and motorist merges right)	No Separate Right Turn Lane (Bike in Shared Lane)	No Separate Right Turn Lane (Bike in Shared Lane)
Score		0	0	0
Right Turns on "Red"	Prohibited (or no conflict because right turns are not permitted/ possible)	Prohibited (or no conflict because right turns are not permitted/ possible)	Prohibited (or no conflict because right turns are not permitted/ possible)	Prohibited (or no conflict because right turns are not permitted/ possible)
Score		5	5	5
Intersection Crossing Distance	≤ 3 motor vehicle travel lanes	≤ 3 motor vehicle travel lanes	4 to 5 motor vehicle travel lanes	4 to 5 motor vehicle travel lanes
Score		0	0	-5
Approach Total		35	35	50
Approach LOS		E	E	D
Intersection AVG.				42.5
Intersection Before BLOS.		D		

# Bernard and Haley Bicycle Level of Service (BLOS)

\*Based on PLOS and BLOS for signalized intersections methodology: Smart Growth for America

<https://www.smartgrowthamerica.org/app/legacy/documents/cs/impl/nc-charlotte-pedbikelos.pdf>

## Bike Level of Service (BLOS)

Points	LOS
93+	A
74 - 92	B
55 - 73	C
37 - 54	D
19 - 36	E
0 - 18	F

Location: Bernard Street & Haley Street (Roundabout)

## AFTER BLOS

	EB Bernard	WB Bernard	NB Haley	SB Haley	
Bike Travel Way & Speed of Adjacent Traffic	Shared Wide Curb Lane to Wide Curb Lane ≥ 40mph	Shared Wide Curb Lane to Wide Curb Lane ≥ 40mph	Shared Wide Curb Lane to Wide Curb Lane 30-35 mph	Shared Wide Curb Lane to Wide Curb Lane 30-35 mph	
Score		30	30	50	50
Intersection Features					
Opposing Vehicular Left Turn	No Left Turn Conflict	No Left Turn Conflict	No Left Turn Conflict	No Left Turn Conflict	
Score		15	15	15	15
Stop Bar Location	Shared stop bar - automobiles & bikes stop at common point	Shared stop bar - automobiles & bikes stop at common point	Shared stop bar - automobiles & bikes stop at common point	Shared stop bar - automobiles & bikes stop at common point	
Score		0	0	0	0
Right Turning Traffic Conflict	No Right Turn Conflict	No Right Turn Conflict	No Right Turn Conflict	No Right Turn Conflict	
Score		15	15	15	15
Shared Traffic Lane/Separate Right Turn Traffic Lane	Curb lane drops as right turn lane, with bike lane left of turn lane (cyclist merges left, motorist merges right)	Curb lane drops as right turn lane, with bike lane left of turn lane (cyclist merges left, motorist merges right)	No Separate Right Turn Lane (Bike in Shared Lane)	No Separate Right Turn Lane (Bike in Shared Lane)	
Score		5	5	0	0
Right Turns on "Red"	Prohibited (or no conflict because right turns are not permitted/ possible)	Prohibited (or no conflict because right turns are not permitted/ possible)	Prohibited (or no conflict because right turns are not permitted/ possible)	Prohibited (or no conflict because right turns are not permitted/ possible)	
Score		5	5	5	5
Intersection Crossing Distance	≤ 3 motor vehicle travel lanes	≤ 3 motor vehicle travel lanes	≤ 3 motor vehicle travel lanes	≤ 3 motor vehicle travel lanes	
Score		0	0	0	0
Approach Total		70	70	85	85
Approach LOS					
Intersection AVG.					77.5
Intersection After BLOS.		B			

# Bernard and Haley Before Pedestrian Level of Service (PLOS)

\*Based on PLOS and BLOS for signalized intersections methodology: Smart Growth for America  
<https://www.smartgrowthamerica.org/app/legacy/documents/cs/impl/nc-charlotte-pedbikelos.pdf>

## Pedestrian Level of Service (PLOS)

Points	LOS
93+	A
74 - 92	B
55 - 73	C
37 - 54	D
19 - 36	E
0 - 18	F

Location: Bernard Street & Haley Street (AWCS)

## BEFORE PLOS

	EB Bernard	WB Bernard	NB Haley	SB Haley	
Pedestrian Crossing Distance	3 Lanes	3 Lanes	4 Lanes	4 Lanes	
Score		78	78	65	65
Intersection Features					
Left Turn Conflict (left turns into pedestrian path)	Left Turn Conflicts (Left Turns into Pedestrian Crossing Path) From SINGLE lane, no pedestrian phase on conflicting crossing	Left Turn Conflicts (Left Turns into Pedestrian Crossing Path) From SINGLE lane, no pedestrian phase on conflicting crossing	Left Turn Conflicts (Left Turns into Pedestrian Crossing Path) From SINGLE lane, no pedestrian phase on conflicting crossing	Left Turn Conflicts (Left Turns into Pedestrian Crossing Path) From SINGLE lane, no pedestrian phase on conflicting crossing	
Score		-5	-5	-5	-5
Right Turn Conflict (right turns into pedestrian path)	Rights on GREEN BALL Only (permissive phase) From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing	Rights on GREEN BALL Only (permissive phase) From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing	Rights on GREEN BALL Only (permissive phase) From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing	Rights on GREEN BALL Only (permissive phase) From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing	
Score		0	0	0	0
Pedestrian Signal Display	No Pedestrian Phase	No Pedestrian Phase	No Pedestrian Phase	No Pedestrian Phase	
Score		-5	-5	-5	-5
Corner Radius	Radius > 60'	Radius > 40' and ≤ 60'	Radius > 30' and ≤ 40'	Radius > 60'	
Score		-15	-10	0	-15
Right Turns on "Red"	Allowed	Allowed	Allowed	Allowed	
Score		0	0	0	0
Crosswalks	No designated crosswalk	Painted crosswalk - Transverse markings	Painted crosswalk - Transverse markings	Painted crosswalk - Transverse markings	
Score		-5	0	0	0
Approach Total		48	58	55	40
Approach LOS		B	C	C	B
Intersection AVG.			50.25		
Intersection Before PLOS.		D			



## Bernard and Haley After Pedestrian Level of Service (PLOS)

\*Based on PLOS and BLOS for signalized intersections methodology: Smart Growth for America

<https://www.smartgrowthamerica.org/app/legacy/documents/cs/impl/nc-charlotte-pedbikelos.pdf>

### Pedestrian Level of Service (PLOS)

Points	LOS
93+	A
74 - 92	B
55 - 73	C
37 - 54	D
19 - 36	E
0 - 18	F

Location: Bernard Street & Haley Street (Roundabout)

### AFTER PLOS

	EB Bernard	WB Bernard	NB Haley	SB Haley
Pedestrian Crossing Distance	4 Lanes	4 Lanes	2 Lanes	2 Lanes
Score		65	65	80
Intersection Features				
Left Turn Conflict (left turns into pedestrian path)	No Left Turn Conflict	No Left Turn Conflict	No Left Turn Conflict	No Left Turn Conflict
Score		15	15	15
Right Turn Conflict (right turns into pedestrian path)	Rights on GREEN BALL Only (permissive phase) From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing	Rights on GREEN BALL Only (permissive phase) From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing	Rights on GREEN BALL Only (permissive phase) From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing	Rights on GREEN BALL Only (permissive phase) From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing
Score		0	0	0
Pedestrian Signal Display	No Pedestrian Phase	No Pedestrian Phase	No Pedestrian Phase	No Pedestrian Phase
Score		-5	-5	-5
Corner Radius	Curbed Low Speed Design Slip Lane (Figure B) - Right turns on Yield, Green Ball or Green Arrow/Green Ball (& Pedestrian crossing at location B)	Curbed Low Speed Design Slip Lane (Figure B) - Right turns on Yield, Green Ball or Green Arrow/Green Ball (& Pedestrian crossing at location B)	Curbed Low Speed Design Slip Lane (Figure B) - Right turns on Yield, Green Ball or Green Arrow/Green Ball (& Pedestrian crossing at location B)	Curbed Low Speed Design Slip Lane (Figure B) - Right turns on Yield, Green Ball or Green Arrow/Green Ball (& Pedestrian crossing at location B)
Score		0	0	0
Right Turns on "Red"	Allowed	Allowed	Allowed	Allowed
Score		0	0	0
Crosswalks	Painted crosswalk - LADDER type markings	Painted crosswalk - LADDER type markings	Painted crosswalk - LADDER type markings	Painted crosswalk - LADDER type markings
Score		5	5	5
Approach Total		80	80	95
Approach LOS		A	A	A
Intersection AVG.			87.5	
Intersection After PLOS.		B		



# APPENDIX

- 1) CONSULTANT EMISSIONS  
CALCULATIONS
- 2) CONSULTANT L.O.S.  
CALCULATIONS
- 3) B.L.O.S. AND P.L.O.S.  
METHODOLOGY

CMAQ Roundabout Project:  
Bernard Street and Haley Street  
(East Bakersfield)

Project Limits: Intersection of Bernard Street and Haley Street

### **Appendix – Emissions Calculations Procedure**

#### **Example:**

Emission Factors: NO<sub>x</sub> Nontruck (NO<sub>x-NT</sub>) = 67.593 g/hr; NO<sub>x</sub> Truck (NO<sub>x-T</sub>) = 31.887 g/hr

Project emission factor for NO<sub>x</sub> = (NO<sub>x-NT</sub>) x (%NT) + (NO<sub>x-T</sub>) x (%T)

AWSC AM NO<sub>x</sub> emission factor = (67.593 g/hr x 0.973) + (31.887 x 0.027) = 66.629 g/hr

AWSC AM NO<sub>x</sub> emissions = 66.629 g/hr x (1,081 veh) x (15.6 sec/veh) x (1 hr/3,600 sec)

AWSC AM NO<sub>x</sub> emissions = 0.312 kg

AWSC MD NO<sub>x</sub> emission factor = (67.593 g/hr x 0.981) + (31.887 x 0.019) = 66.914 g/hr

AWSC MD NO<sub>x</sub> emissions = 66.914 g/hr x (1,233 veh) x (17.3 sec/veh) x (1 hr/3,600 sec)

AWSC MD NO<sub>x</sub> emissions = 0.396 kg

AWSC PM NO<sub>x</sub> emission factor = (67.593 g/hr x 0.994) + (31.887 x 0.006) = 67.379 g/hr

AWSC PM NO<sub>x</sub> emissions = 67.379 g/hr x (1,407 veh) x (20.4 sec/veh) x (1 hr/3,600 sec)

AWSC PM NO<sub>x</sub> emissions = 0.537 kg

AWSC Daily NO<sub>x</sub> emissions = (0.312 kg + 0.396 kg + 0.537 kg) x 2 = 2.492 kg

Sum of AM+MD+PM delay was doubled to represent daily delay. Process repeated for VOC, NO<sub>x</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, and CO using volumes and average vehicle delay presented in **Table 1**.

Calculation spreadsheets can be found on ensuing pages.

### Omni-Means Traffic Data - Delay and Turning Movements

[illegible]

# **Omni-Means Traffic Data - Delay and Turning Movements**

Ped-Bike Adj (A_pbT)	1		1	1		1	1		1	1		1
Parking Bus Adj	1	1	1	1	1	1	1	1	1	1	1	1
Adj Sat Flow, veh/h/ln	1900	1845	1900	1900	1845	1900	1845	1845	1900	1845	1845	1900
Adj Flow Rate, veh/h	32	171	42	27	173	70	33	202	21	138	239	52
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	185	385	87	172	349	131	535	612	64	591	547	119
HCM Platoon Ratio	1	1	1	1	1	1	1	1	1	1	1	1
Prop Arrive On Green	0.3	0.3	0.3	0.3	0.3	0.3	0.37	0.37	0.37	0.37	0.37	0.37
Ln Grp Delay, s/veh	8.1	0	0	8.4	0	0	7.9	0	6.4	8.1	0	6.8
Ln Grp LOS	A			A			A		A	A		A
Approach Vol, veh/h		245			270			256			429	
Approach Delay, s/veh		8.1			8.4			6.6			7.2	

SigInt-MD	Delay (s/v)	8.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	Total
Traffic Volume (veh/h)	67	207	38	32	237	62	38	152	22	121	194	63	1233
Future Volume (veh/h)	67	207	38	32	237	62	38	152	22	121	194	63	1233
Number	7	4	14	3	8	18	5	2	12	1	6	16	
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0	
Ped-Bike Adj (A_pbT)	1		1	1		1	1		1	1		1	
Parking Bus Adj	1	1	1	1	1	1	1	1	1	1	1	1	
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1863	1863	1900	1863	1863	1900	
Adj Flow Rate, veh/h	73	225	41	35	258	67	41	165	24	132	211	68	
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2	
Opposing Right Turn Influence	Yes			Yes			Yes			Yes			
Cap, veh/h	231	445	72	166	474	115	481	533	78	555	453	146	
HCM Platoon Ratio	1	1	1	1	1	1	1	1	1	1	1	1	
Prop Arrive On Green	0.35	0.35	0.35	0.35	0.35	0.35	0.34	0.34	0.34	0.34	0.34	0.34	
Ln Grp Delay, s/veh	7.9	0	0	8	0	0	9.4	0	7.4	9.2	0	8.2	



### Omni-Means Traffic Data - Delay and Turning Movements

Ln Grp LOS	A			A			A			A			A		
Approach Vol, veh/h	339			360			230			411					
Approach Delay, s/veh	7.9			8			7.8			8.5					
Approach LOS	A			A			A			A					
SIGINT-PM	Delay (S/v)	8.7													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR			
Lane Configurations													Total		
Traffic Volume (veh/h)	66	263	34	38	239	116	45	175	44	124	206	57	1407		
Future Volume (veh/h)	66	263	34	38	239	116	45	175	44	124	206	57	1407		
Number	7	4	14	3	8	18	5	2	12	1	6	16			
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj (A_pbT)	1		1	1		1	1		1	1		1			
Parking Bus Adj	1	1	1	1	1	1	1	1	1	1	1	1			
Adj Sat Flow, veh/h/ln	1900	1881	1900	1900	1881	1900	1881	1881	1900	1881	1881	1900			
Adj Flow Rate, veh/h	69	277	36	40	252	122	47	184	46	131	217	60			
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0			
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95			
Percent Heavy Veh, %	1	1	1	1	1	1	1	1	1	1	1	1			
Opposing Right Turn Influence	Yes			Yes			Yes			Yes					
Cap, veh/h	205	516	61	156	424	190	475	499	125	513	487	135			
HCM Platoon Ratio	1	1	1	1	1	1	1	1	1	1	1	1			
Prop Arrive On Green	0.37	0.37	0.37	0.37	0.37	0.37	0.34	0.34	0.34	0.34	0.34	0.34			
Ln Grp Delay, s/veh	8.3	0	0	8.7	0	0	10.1	0	8.2	10.4	0	8.6			
Ln Grp LOS	A			A			B		A	B		A			
Approach Vol, veh/h	382			414			277			408					
Approach Delay, s/veh	8.3			8.7			8.5			9.2					
Approach LOS	A			A			A			A					
RAB-AM	Vol	Delay	HV%												
	1201	7	2.7												
RAB-MD	1340	7.9	1.9												
RAB-PM	1481	8.4	0.6												

**EMFAC2014 Emission Rates**  
**(grams/hour)**

2018 Kern (SJV)	NonTruck	IDLEX	CO	28.77876157	
2018 Kern (SJV)	Truck	IDLEX	CO	5.396632379	
2018 Kern (SJV)	NonTruck	IDLEX	NOx	67.5928921	
2018 Kern (SJV)	Truck	IDLEX	NOx	31.88689674	
2018 Kern (SJV)	NonTruck	IDLEX	PM10	0.082294794	
2018 Kern (SJV)	Truck	IDLEX	PM10	0.059520018	
2018 Kern (SJV)	NonTruck	IDLEX	PM2_5	0.078734757	
2018 Kern (SJV)	Truck	IDLEX	PM2_5	0.056945208	
2018 Kern (SJV)	NonTruck	IDLEX	ROG	3.548930043	
2018 Kern (SJV)	NonTruck	RUNLOSS	ROG	1.942732219	5.491662
2018 Kern (SJV)	Truck	IDLEX	ROG	1.220264526	
2018 Kern (SJV)	Truck	RUNLOSS	ROG	4.65018106	5.870446

# EMISSION CALCULATIONS

Intersection	Configuration	Period	Flow (v/h)	Avg Delay (s/v)	Total Delay (hr)	Truck %	CO-NT (g/hr)	CO-T (g/hr)	CO (kg)
Bernard/Haley	AWSC	AM	1081	15.6	4.68	2.7%	28.77876157	5.39663238	0.132
Bernard/Haley	AWSC	MD	1233	17.3	5.93	1.9%	28.77876157	5.39663238	0.168
Bernard/Haley	AWSC	PM	1407	20.4	7.97	0.6%	28.77876157	5.39663238	0.228
	<b>AWSC Total</b>				18.58				0.528
Bernard/Haley	RAB	AM	1201	7	2.34	2.7%	28.77876157	5.39663238	0.066
Bernard/Haley	RAB	MD	1340	7.9	2.94	1.9%	28.77876157	5.39663238	0.083
Bernard/Haley	RAB	PM	1481	8.4	3.46	0.6%	28.77876157	5.39663238	0.099
	<b>RAB Total</b>				8.73				0.248

# EMISSION CALCULATIONS

Intersection	Configuration	Period	ROG-NT (g/hr)	ROG-T (g/hr)	ROG (kg)	NOX-NT (g/hr)	NOX-T (g/hr)	NOX (kg)
Bernard/Haley	AWSC	AM	5.492	5.870	0.026	67.593	31.887	0.312
Bernard/Haley	AWSC	MD	5.492	5.870	0.033	67.593	31.887	0.396
Bernard/Haley	AWSC	PM	5.492	5.870	0.044	67.593	31.887	0.537
	<b>AWSC Total</b>				0.102			1.246
Bernard/Haley	RAB	AM	5.492	5.870	0.013	67.593	31.887	0.156
Bernard/Haley	RAB	MD	5.492	5.870	0.016	67.593	31.887	0.197
Bernard/Haley	RAB	PM	5.492	5.870	0.019	67.593	31.887	0.233
	<b>RAB Total</b>				0.048			0.585

# EMISSION CALCULATIONS

Intersection	Configuration	Period	PM10-NT (g/hr)	PM10-T (g/hr)	PM10 (kg)	PM25-NT (g/hr)	PM25-T (g/hr)	PM25 (kg)
Bernard/Haley	AWSC	AM	0.082	0.060	0.00038	0.078734757	0.056945208	0.00037
Bernard/Haley	AWSC	MD	0.082	0.060	0.00049	0.078734757	0.056945208	0.00046
Bernard/Haley	AWSC	PM	0.082	0.060	0.00066	0.078734757	0.056945208	0.00063
	<b>AWSC Total</b>				0.00152			0.00146
Bernard/Haley	RAB	AM	0.082	0.060	0.00019	0.078734757	0.056945208	0.00018
Bernard/Haley	RAB	MD	0.082	0.060	0.00024	0.078734757	0.056945208	0.00023
Bernard/Haley	RAB	PM	0.082	0.060	0.00028	0.078734757	0.056945208	0.00027
	<b>RAB Total</b>				0.00072			0.00068



### Summary

#### PH (AM+MD+PM)

Configuration	Total Delay (hr)	ROG (kg)	NOX (kg)	PM10 (kg)	PM25 (kg)	CO (kg)
AWSC Total	18.583	0.102	1.246	0.0015	0.0015	0.528
RAB Total	8.732	0.048	0.585	0.0007	0.0007	0.248

#### Daily (PHX2)

AWSC Total	37.165	0.204	2.492	0.003	0.003	1.056
RAB Total	17.463	0.096	1.170	0.001	0.001	0.496

Daily Reductions	19.702	0.108	1.321	0.002	0.002	0.560
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## **Bernard Street/Haley Street**



**Metro Traffic Data Inc.**  
310 N. Irwin Street - Suite 20  
Hanford, CA 93230  
800-975-6938 Phone/Fax  
www.metrotrafficdata.com

# Turning Movement Report

Prepared For:

**OMNI-Means**  
943 Reserve Drive  
Roseville, CA 95678

**LOCATION** Bernard St @ Haley St  
**COUNTY** Kern  
**COLLECTION DATE** 5/18/2017

**LATITUDE** 35.3889  
**LONGITUDE** -118.9769  
**WEATHER** Clear

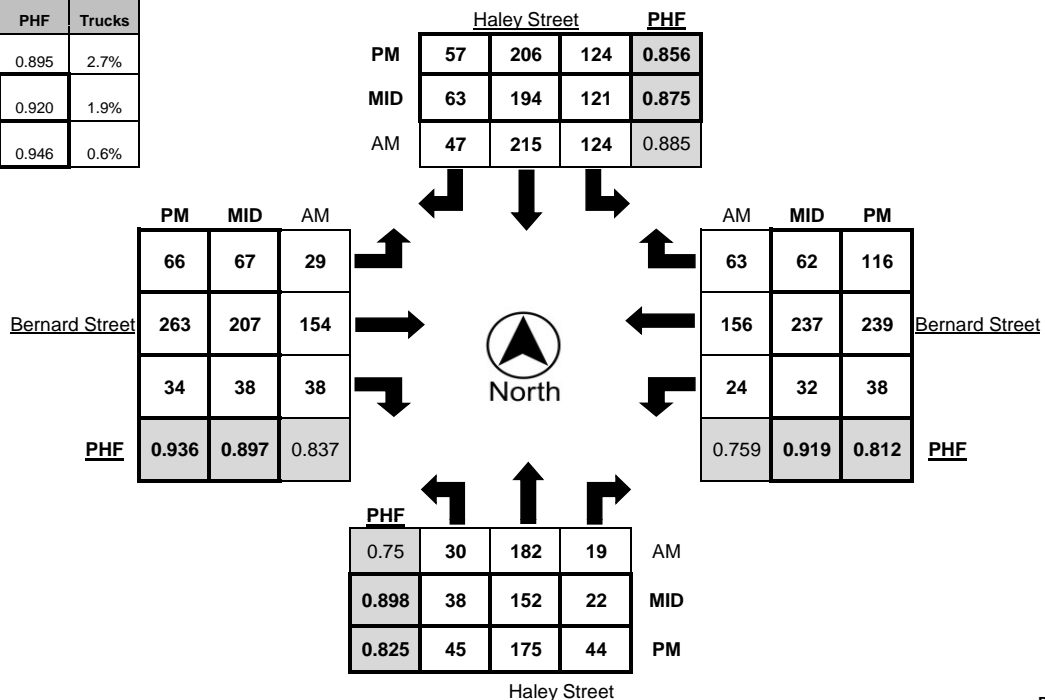
	Northbound				Southbound				Eastbound				Westbound			
Time	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks
7:00 AM - 7:15 AM	3	9	8	0	15	23	4	2	5	30	2	1	3	16	9	0
7:15 AM - 7:30 AM	3	42	5	4	22	40	10	3	6	37	7	1	8	26	11	3
7:30 AM - 7:45 AM	11	59	7	3	26	61	17	1	11	29	11	1	4	45	16	0
7:45 AM - 8:00 AM	7	48	4	1	40	55	14	4	6	42	6	1	4	54	22	2
8:00 AM - 8:15 AM	9	33	3	1	36	59	6	4	6	46	14	0	8	31	14	0
8:15 AM - 8:30 AM	10	20	5	1	18	26	14	0	10	29	13	0	3	37	14	0
8:30 AM - 8:45 AM	7	20	3	3	10	20	7	0	11	27	5	0	7	25	10	1
8:45 AM - 9:00 AM	11	23	7	0	16	29	13	0	18	28	9	0	2	31	9	0
<b>TOTAL</b>	<b>61</b>	<b>254</b>	<b>42</b>	<b>13</b>	<b>183</b>	<b>313</b>	<b>85</b>	<b>14</b>	<b>73</b>	<b>268</b>	<b>67</b>	<b>4</b>	<b>39</b>	<b>265</b>	<b>105</b>	<b>6</b>

	Northbound				Southbound				Eastbound				Westbound			
Time	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks
12:30 PM - 12:45 PM	8	20	3	0	26	41	14	1	10	51	5	0	6	60	17	1
12:45 PM - 1:00 PM	17	31	9	2	27	38	16	1	16	59	9	1	9	49	12	0
1:00 PM - 1:15 PM	6	34	4	0	28	46	16	3	11	51	10	0	6	53	21	0
1:15 PM - 1:30 PM	11	38	8	2	20	36	12	4	17	42	7	1	5	46	17	3
1:30 PM - 1:45 PM	7	26	6	2	24	54	19	2	15	49	9	0	9	47	15	1
1:45 PM - 2:00 PM	8	26	5	2	27	49	13	0	13	66	10	0	9	48	16	0
2:00 PM - 2:15 PM	9	30	4	0	26	35	18	2	12	40	8	0	5	56	16	1
2:15 PM - 2:30 PM	7	42	6	2	25	51	12	0	18	54	12	3	7	61	17	1
2:30 PM - 2:45 PM	9	46	4	2	30	60	18	6	16	53	12	0	12	52	15	1
2:45 PM - 3:00 PM	13	34	8	1	40	48	15	3	21	60	6	1	8	68	14	0
<b>TOTAL</b>	<b>95</b>	<b>327</b>	<b>57</b>	<b>13</b>	<b>273</b>	<b>458</b>	<b>153</b>	<b>22</b>	<b>149</b>	<b>525</b>	<b>88</b>	<b>6</b>	<b>76</b>	<b>540</b>	<b>160</b>	<b>8</b>

	Northbound				Southbound				Eastbound				Westbound			
Time	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks
4:00 PM - 4:15 PM	9	35	11	0	29	65	15	2	13	56	14	1	9	54	11	1
4:15 PM - 4:30 PM	11	32	6	0	32	41	12	0	26	57	17	0	8	49	12	1
4:30 PM - 4:45 PM	14	44	7	0	33	47	19	1	15	54	21	0	3	58	12	0
4:45 PM - 5:00 PM	14	30	11	2	24	61	15	0	14	89	5	0	8	63	12	0
5:00 PM - 5:15 PM	10	51	19	1	36	47	19	0	19	70	6	0	9	61	22	0
5:15 PM - 5:30 PM	9	41	9	0	24	55	8	0	12	66	11	0	9	65	8	2
5:30 PM - 5:45 PM	15	43	6	1	36	56	21	1	18	70	9	1	11	57	30	1
5:45 PM - 6:00 PM	11	40	10	0	28	48	9	0	17	57	8	0	9	56	56	1
<b>TOTAL</b>	<b>93</b>	<b>316</b>	<b>79</b>	<b>4</b>	<b>242</b>	<b>420</b>	<b>118</b>	<b>4</b>	<b>134</b>	<b>519</b>	<b>91</b>	<b>2</b>	<b>66</b>	<b>463</b>	<b>163</b>	<b>6</b>

	Northbound				Southbound				Eastbound				Westbound			
PEAK HOUR	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks	Left	Thru	Right	Trucks
7:15 AM - 8:15 AM	30	182	19	9	124	215	47	12	29	154	38	3	24	156	63	5
2:00 PM - 3:00 PM	38	152	22	5	121	194	63	11	67	207	38	4	32	237	62	3
5:00 PM - 6:00 PM	45	175	44	2	124	206	57	1	66	263	34	1	38	239	116	4

	PHF	Trucks
AM	0.895	2.7%
MID	0.920	1.9%
PM	0.946	0.6%





**Metro Traffic Data Inc.**  
310 N. Irwin Street - Suite 20  
Hanford, CA 93230  
800-975-6938 Phone/Fax  
www.metrotrafficdata.com

# Turning Movement Report

Prepared For:

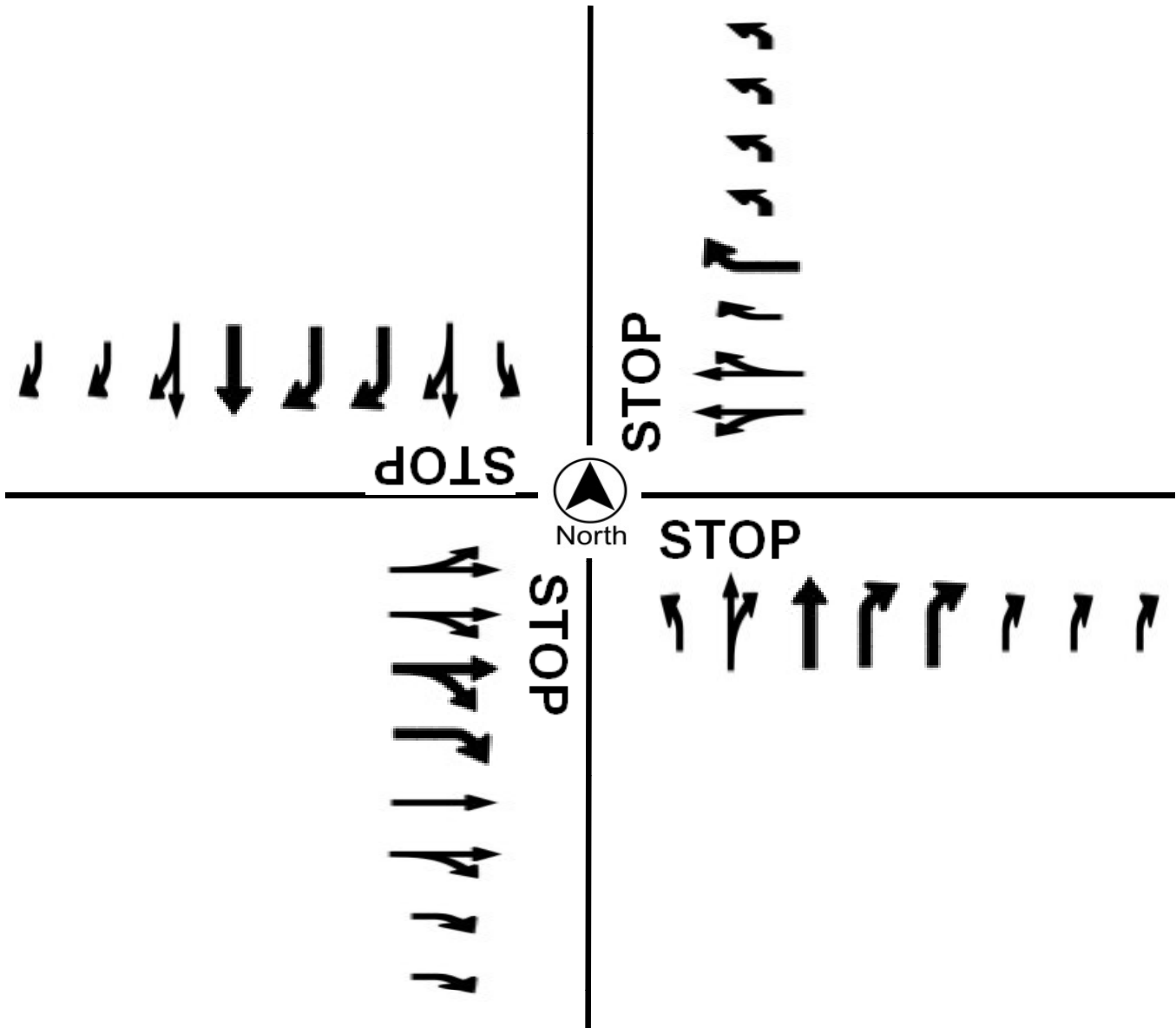
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**OMNI-Means**  
943 Reserve Drive  
Roseville, CA 95678

**LOCATION** Bernard St @ Haley St  
**COUNTY** Kern  
**COLLECTION DATE** 5/18/2017  
**CYCLE TIME** N/A

**N/S STREET** Haley Street  
**E/W STREET** Bernard Street  
**WEATHER** Clear  
**CONTROL TYPE** All-Way Stop

## COMMENTS



Intersection												
Intersection Delay, s/veh	15.6											
Intersection LOS	C											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	29	154	38	0	24	156	63	0	30	182	19
Future Vol, veh/h	0	29	154	38	0	24	156	63	0	30	182	19
Peak Hour Factor	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	3	3	3	2	3	3	3	2	3	3	3
Mvmt Flow	0	32	171	42	0	27	173	70	0	33	202	21
Number of Lanes	0	0	2	0	0	0	2	1	0	1	1	0
Approach												
	EB				WB				NB			
Opposing Approach	WB				EB				SB			
Opposing Lanes	3				2				2			
Conflicting Approach Left	SB				NB				EB			
Conflicting Lanes Left	2				2				2			
Conflicting Approach Right	NB				SB				WB			
Conflicting Lanes Right	2				2				3			
HCM Control Delay	13.6				12.7				16.8			
HCM LOS	B				B				C			
Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2			
Vol Left, %	100%	0%	27%	0%	24%	0%	0%	100%	0%			
Vol Thru, %	0%	91%	73%	67%	76%	93%	0%	0%	82%			
Vol Right, %	0%	9%	0%	33%	0%	7%	100%	0%	18%			
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop			
Traffic Vol by Lane	30	201	106	115	102	84	57	124	262			
LT Vol	30	0	29	0	24	0	0	124	0			
Through Vol	0	182	77	77	78	78	0	0	215			
RT Vol	0	19	0	38	0	6	57	0	47			
Lane Flow Rate	33	223	118	128	113	94	63	138	291			
Geometry Grp	8	8	8	8	8	8	8	8	8			
Degree of Util (X)	0.077	0.479	0.266	0.275	0.254	0.205	0.126	0.301	0.586			
Departure Headway (Hd)	8.302	7.724	8.125	7.747	8.055	7.88	7.216	7.877	7.241			
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Cap	431	465	440	463	444	454	495	456	498			
Service Time	6.07	5.493	5.897	5.518	5.825	5.65	4.985	5.639	5.003			
HCM Lane V/C Ratio	0.077	0.48	0.268	0.276	0.255	0.207	0.127	0.303	0.584			
HCM Control Delay	11.8	17.5	13.8	13.5	13.6	12.7	11	14	19.8			
HCM Lane LOS	B	C	B	B	B	B	B	B	C			
HCM 95th-tile Q	0.2	2.5	1.1	1.1	1	0.8	0.4	1.3	3.7			

Intersection				
Intersection Delay, s/veh				
Intersection LOS				
Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	124	215	47
Future Vol, veh/h	0	124	215	47
Peak Hour Factor	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	3	3	3
Mvmt Flow	0	138	239	52
Number of Lanes	0	1	1	0
Approach		SB		
Opposing Approach		NB		
Opposing Lanes		2		
Conflicting Approach Left		WB		
Conflicting Lanes Left		3		
Conflicting Approach Right		EB		
Conflicting Lanes Right		2		
HCM Control Delay		17.9		
HCM LOS		C		
Lane				



Intersection												
Intersection Delay, s/veh	17.3											
Intersection LOS	C											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	67	207	38	0	32	237	62	0	38	152	22
Future Vol, veh/h	0	67	207	38	0	32	237	62	0	38	152	22
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	73	225	41	0	35	258	67	0	41	165	24
Number of Lanes	0	0	2	0	0	0	2	1	0	1	1	0
Approach												
	EB				WB				NB			
Opposing Approach	WB				EB				SB			
Opposing Lanes	3				2				2			
Conflicting Approach Left	SB				NB				EB			
Conflicting Lanes Left	2				2				2			
Conflicting Approach Right	NB				SB				WB			
Conflicting Lanes Right	2				2				3			
HCM Control Delay	16.6				14.9				17.2			
HCM LOS	C				B				C			
Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2			
Vol Left, %	100%	0%	39%	0%	21%	0%	0%	100%	0%			
Vol Thru, %	0%	87%	61%	73%	79%	95%	0%	0%	75%			
Vol Right, %	0%	13%	0%	27%	0%	5%	100%	0%	25%			
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop			
Traffic Vol by Lane	38	174	171	142	151	125	56	121	257			
LT Vol	38	0	67	0	32	0	0	121	0			
Through Vol	0	152	104	104	119	119	0	0	194			
RT Vol	0	22	0	38	0	6	56	0	63			
Lane Flow Rate	41	189	185	154	164	136	61	132	279			
Geometry Grp	8	8	8	8	8	8	8	8	8			
Degree of Util (X)	0.105	0.45	0.437	0.346	0.38	0.31	0.127	0.312	0.609			
Departure Headway (Hd)	9.163	8.558	8.603	8.206	8.485	8.339	7.654	8.645	7.958			
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Cap	394	424	421	441	427	434	471	418	455			
Service Time	6.863	6.258	6.303	5.906	6.185	6.039	5.354	6.345	5.658			
HCM Lane V/C Ratio	0.104	0.446	0.439	0.349	0.384	0.313	0.13	0.316	0.613			
HCM Control Delay	12.9	18.1	17.8	15.2	16.3	14.7	11.5	15.2	22.3			
HCM Lane LOS	B	C	C	C	C	B	B	C	C			
HCM 95th-tile Q	0.3	2.3	2.2	1.5	1.7	1.3	0.4	1.3	4			

Intersection				
Intersection Delay, s/veh				
Intersection LOS				
Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	121	194	63
Future Vol, veh/h	0	121	194	63
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	132	211	68
Number of Lanes	0	1	1	0
Approach		SB		
Opposing Approach		NB		
Opposing Lanes		2		
Conflicting Approach Left		WB		
Conflicting Lanes Left		3		
Conflicting Approach Right		EB		
Conflicting Lanes Right		2		
HCM Control Delay		20		
HCM LOS		C		
Lane				



















Intersection												
Intersection Delay, s/veh	20.4											
Intersection LOS	C											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	66	263	34	0	38	239	116	0	45	175	44
Future Vol, veh/h	0	66	263	34	0	38	239	116	0	45	175	44
Peak Hour Factor	0.92	0.95	0.95	0.95	0.92	0.95	0.95	0.95	0.92	0.95	0.95	0.95
Heavy Vehicles, %	1	1	1	1	1	1	1	1	1	1	1	1
Mvmt Flow	0	69	277	36	0	40	252	122	0	47	184	46
Number of Lanes	0	0	2	0	0	0	2	1	0	1	1	0
Approach												
	EB				WB				NB			
Opposing Approach	WB				EB				SB			
Opposing Lanes	3				2				2			
Conflicting Approach Left	SB				NB				EB			
Conflicting Lanes Left	2				2				2			
Conflicting Approach Right	NB				SB				WB			
Conflicting Lanes Right	2				2				3			
HCM Control Delay	20				16.3				22			
HCM LOS	C				C				C			
Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2			
Vol Left, %	100%	0%	33%	0%	24%	0%	0%	100%	0%			
Vol Thru, %	0%	80%	67%	79%	76%	91%	0%	0%	78%			
Vol Right, %	0%	20%	0%	21%	0%	9%	100%	0%	22%			
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop			
Traffic Vol by Lane	45	219	198	166	158	131	104	124	263			
LT Vol	45	0	66	0	38	0	0	124	0			
Through Vol	0	175	132	132	120	119	0	0	206			
RT Vol	0	44	0	34	0	12	104	0	57			
Lane Flow Rate	47	231	208	174	166	138	110	131	277			
Geometry Grp	8	8	8	8	8	8	8	8	8			
Degree of Util (X)	0.128	0.58	0.527	0.426	0.417	0.34	0.25	0.338	0.665			
Departure Headway (Hd)	9.713	9.052	9.13	8.807	9.051	8.862	8.202	9.32	8.65			
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Cap	369	399	395	408	398	406	437	385	418			
Service Time	7.482	6.82	6.898	6.575	6.817	6.628	5.967	7.085	6.414			
HCM Lane V/C Ratio	0.127	0.579	0.527	0.426	0.417	0.34	0.252	0.34	0.663			
HCM Control Delay	13.9	23.7	21.7	18	18.2	16.2	13.7	16.8	27.1			
HCM Lane LOS	B	C	C	C	C	C	B	C	D			
HCM 95th-tile Q	0.4	3.5	3	2.1	2	1.5	1	1.5	4.7			

Intersection				
Intersection Delay, s/veh				
Intersection LOS				
Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	124	206	57
Future Vol, veh/h	0	124	206	57
Peak Hour Factor	0.92	0.95	0.95	0.95
Heavy Vehicles, %	1	1	1	1
Mvmt Flow	0	131	217	60
Number of Lanes	0	1	1	0
Approach		SB		
Opposing Approach		NB		
Opposing Lanes		2		
Conflicting Approach Left		WB		
Conflicting Lanes Left		3		
Conflicting Approach Right		EB		
Conflicting Lanes Right		2		
HCM Control Delay		23.8		
HCM LOS		C		
Lane				

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
Existing (AM)

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	29	154	38	24	156	63	30	182	19	124	215	47
Future Volume (veh/h)	29	154	38	24	156	63	30	182	19	124	215	47
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1845	1900	1900	1845	1900	1845	1845	1900	1845	1845	1900
Adj Flow Rate, veh/h	32	171	42	27	173	70	33	202	21	138	239	52
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	185	385	87	172	349	131	535	612	64	591	547	119
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.30	0.30	0.30	0.30	0.30	0.30	0.37	0.37	0.37	0.37	0.37	0.37
Ln Grp Delay, s/veh	8.1	0.0	0.0	8.4	0.0	0.0	7.9	0.0	6.4	8.1	0.0	6.8
Ln Grp LOS	A			A			A		A	A		A
Approach Vol, veh/h		245			270			256			429	
Approach Delay, s/veh		8.1			8.4			6.6			7.2	
Approach LOS		A			A			A			A	
Timer:		1	2	3	4	5	6	7	8			
Assigned Phs			2		4		6		8			
Case No			6.0		8.0		6.0		8.0			
Phs Duration (G+Y+Rc), s			14.6		12.5		14.6		12.5			
Change Period (Y+Rc), s			4.5		4.5		4.5		4.5			
Max Green (Gmax), s			18.0		18.0		18.0		18.0			
Max Allow Headway (MAH), s			5.2		5.5		5.2		5.5			
Max Q Clear (g_c+I1), s			5.9		5.0		7.0		5.4			
Green Ext Time (g_e), s			3.2		2.8		3.0		2.7			
Prob of Phs Call (p_c)			1.00		0.98		1.00		0.98			
Prob of Max Out (p_x)			0.27		0.19		0.33		0.20			
Left-Turn Movement Data												
Assigned Mvmt			5		7		1		3			
Mvmt Sat Flow, veh/h			1073		118		1142		87			
Through Movement Data												
Assigned Mvmt			2		4		6		8			
Mvmt Sat Flow, veh/h			1644		1304		1469		1183			
Right-Turn Movement Data												
Assigned Mvmt			12		14		16		18			
Mvmt Sat Flow, veh/h			171		294		320		444			
Left Lane Group Data												
Assigned Mvmt		0	5	0	7	0	1	0	3			
Lane Assignment					L+T+R				L+T+R			

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
Existing (AM)

Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	33	0	245	0	138	0	270
Grp Sat Flow (s), veh/h/ln	0	1073	0	1717	0	1142	0	1714
Q Serve Time (g_s), s	0.0	0.6	0.0	0.0	0.0	2.7	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	3.9	0.0	3.0	0.0	5.0	0.0	3.4
Perm LT Sat Flow (s_l), veh/h/ln	0	1073	0	1155	0	1142	0	1187
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	1833	0	0	0	1835
Perm LT Eff Green (g_p), s	0.0	10.1	0.0	8.0	0.0	10.1	0.0	8.0
Perm LT Serve Time (g_u), s	0.0	6.8	0.0	4.5	0.0	7.7	0.0	5.0
Perm LT Q Serve Time (g_ps), s	0.0	0.6	0.0	0.0	0.0	2.7	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	3.6	0.0	0.0	0.0	3.8
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	3.0	0.0	0.0	0.0	3.4
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	0.13	0.00	1.00	0.00	0.10
Lane Grp Cap (c), veh/h	0	535	0	657	0	591	0	652
V/C Ratio (X)	0.00	0.06	0.00	0.37	0.00	0.23	0.00	0.41
Avail Cap (c_a), veh/h	0	848	0	1268	0	924	0	1268
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	7.8	0.0	7.8	0.0	7.9	0.0	7.9
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.4
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	7.9	0.0	8.1	0.0	8.1	0.0	8.4
1st-Term Q (Q1), veh/ln	0.0	0.2	0.0	1.4	0.0	0.8	0.0	1.7
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.2	0.0	1.5	0.0	0.8	0.0	1.7
%ile Storage Ratio (RQ%)	0.00	0.05	0.00	0.07	0.00	0.21	0.00	0.06
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Middle Lane Group Data</b>								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment								
Lanes in Grp	0	0	0	0	0	0	0	0
Grp Vol (v), veh/h	0	0	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	0	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	0	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	0	0	0	0	0	0	0
Upstream Filter (I)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street



















CMAQ Roundabouts (Kern County)  
Existing (AM)

2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Right Lane Group Data</b>								
Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R				T+R			
Lanes in Grp	0	1	0	0	0	1	0	0
Grp Vol (v), veh/h	0	223	0	0	0	291	0	0
Grp Sat Flow (s), veh/h/ln	0	1815	0	0	0	1788	0	0
Q Serve Time (g_s), s	0.0	2.4	0.0	0.0	0.0	3.3	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	2.4	0.0	0.0	0.0	3.3	0.0	0.0
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.09	0.00	0.17	0.00	0.18	0.00	0.26
Lane Grp Cap (c), veh/h	0	676	0	0	0	666	0	0
V/C Ratio (X)	0.00	0.33	0.00	0.00	0.00	0.44	0.00	0.00
Avail Cap (c_a), veh/h	0	1206	0	0	0	1188	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	6.1	0.0	0.0	0.0	6.4	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.3	0.0	0.0	0.0	0.5	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	6.4	0.0	0.0	0.0	6.8	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	1.2	0.0	0.0	0.0	1.6	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	1.2	0.0	0.0	0.0	1.7	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.06	0.00	0.00	0.00	0.09	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Intersection Summary</b>								
HCM 2010 Ctrl Delay	7.5							
HCM 2010 LOS	A							

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
Existing Mid-Day

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	67	207	38	32	237	62	38	152	22	121	194	63
Future Volume (veh/h)	67	207	38	32	237	62	38	152	22	121	194	63
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	73	225	41	35	258	67	41	165	24	132	211	68
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	231	445	72	166	474	115	481	533	78	555	453	146
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.35	0.35	0.35	0.35	0.35	0.35	0.34	0.34	0.34	0.34	0.34	0.34
Ln Grp Delay, s/veh	7.9	0.0	0.0	8.0	0.0	0.0	9.4	0.0	7.4	9.2	0.0	8.2
Ln Grp LOS	A			A			A		A	A		A
Approach Vol, veh/h		339			360			230			411	
Approach Delay, s/veh		7.9			8.0			7.8			8.5	
Approach LOS		A			A			A			A	
Timer:		1	2	3	4	5	6	7	8			
Assigned Phs			2		4		6		8			
Case No			6.0		8.0		6.0		8.0			
Phs Duration (G+Y+Rc), s			14.2		14.8		14.2		14.8			
Change Period (Y+Rc), s			4.5		4.5		4.5		4.5			
Max Green (Gmax), s			18.0		18.0		18.0		18.0			
Max Allow Headway (MAH), s			5.2		5.6		5.2		5.6			
Max Q Clear (g_c+I1), s			6.5		6.3		6.9		6.7			
Green Ext Time (g_e), s			2.9		3.7		2.8		3.7			
Prob of Phs Call (p_c)			1.00		1.00		1.00		1.00			
Prob of Max Out (p_x)			0.26		0.37		0.29		0.40			
Left-Turn Movement Data												
Assigned Mvmt			5		7		1		3			
Mvmt Sat Flow, veh/h			1096		227		1189		85			
Through Movement Data												
Assigned Mvmt			2		4		6		8			
Mvmt Sat Flow, veh/h			1591		1255		1351		1337			
Right-Turn Movement Data												
Assigned Mvmt			12		14		16		18			
Mvmt Sat Flow, veh/h			231		204		435		325			
Left Lane Group Data												
Assigned Mvmt		0	5	0	7	0	1	0	3			
Lane Assignment					L+T+R				L+T+R			

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

# CMAQ Roundabouts (Kern County)

Existing Mid-Day

Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	41	0	339	0	132	0	360
Grp Sat Flow (s), veh/h/ln	0	1096	0	1686	0	1189	0	1748
Q Serve Time (g_s), s	0.0	0.9	0.0	0.0	0.0	2.7	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	4.5	0.0	4.3	0.0	4.9	0.0	4.7
Perm LT Sat Flow (s_l), veh/h/ln	0	1096	0	1072	0	1189	0	1131
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	1843	0	0	0	1854
Perm LT Eff Green (g_p), s	0.0	9.7	0.0	10.3	0.0	9.7	0.0	10.3
Perm LT Serve Time (g_u), s	0.0	6.2	0.0	5.6	0.0	7.5	0.0	6.0
Perm LT Q Serve Time (g_ps), s	0.0	0.9	0.0	0.0	0.0	2.7	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	3.6	0.0	0.0	0.0	5.0
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	3.6	0.0	0.0	0.0	4.7
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	0.22	0.00	1.00	0.00	0.10
Lane Grp Cap (c), veh/h	0	481	0	749	0	555	0	756
V/C Ratio (X)	0.00	0.09	0.00	0.45	0.00	0.24	0.00	0.48
Avail Cap (c_a), veh/h	0	793	0	1166	0	895	0	1206
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	9.4	0.0	7.4	0.0	9.0	0.0	7.6
Incr Delay (d2), s/veh	0.0	0.1	0.0	0.4	0.0	0.2	0.0	0.5
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	9.4	0.0	7.9	0.0	9.2	0.0	8.0
1st-Term Q (Q1), veh/ln	0.0	0.3	0.0	2.1	0.0	0.9	0.0	2.3
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.3	0.0	2.2	0.0	0.9	0.0	2.4
%ile Storage Ratio (RQ%)	0.00	0.06	0.00	0.10	0.00	0.23	0.00	0.08
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Middle Lane Group Data</b>								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment								
Lanes in Grp	0	0	0	0	0	0	0	0
Grp Vol (v), veh/h	0	0	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	0	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	0	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	0	0	0	0	0	0	0
Upstream Filter (I)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

# CMAQ Roundabouts (Kern County)

Existing Mid-Day

2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

### Right Lane Group Data

Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R				T+R			
Lanes in Grp	0	1	0	0	0	1	0	0
Grp Vol (v), veh/h	0	189	0	0	0	279	0	0
Grp Sat Flow (s), veh/h/ln	0	1822	0	0	0	1786	0	0
Q Serve Time (g_s), s	0.0	2.2	0.0	0.0	0.0	3.6	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	2.2	0.0	0.0	0.0	3.6	0.0	0.0
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.13	0.00	0.12	0.00	0.24	0.00	0.19
Lane Grp Cap (c), veh/h	0	611	0	0	0	599	0	0
V/C Ratio (X)	0.00	0.31	0.00	0.00	0.00	0.47	0.00	0.00
Avail Cap (c_a), veh/h	0	1130	0	0	0	1108	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	7.2	0.0	0.0	0.0	7.6	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.3	0.0	0.0	0.0	0.6	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	7.4	0.0	0.0	0.0	8.2	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	1.1	0.0	0.0	0.0	1.7	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	1.2	0.0	0.0	0.0	1.8	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.06	0.00	0.00	0.00	0.09	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



















### Intersection Summary

HCM 2010 Ctrl Delay	8.1
HCM 2010 LOS	A

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
Existing (PM)

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	66	263	34	38	239	116	45	175	44	124	206	57
Future Volume (veh/h)	66	263	34	38	239	116	45	175	44	124	206	57
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1881	1900	1900	1881	1900	1881	1881	1900	1881	1881	1900
Adj Flow Rate, veh/h	69	277	36	40	252	122	47	184	46	131	217	60
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	1	1	1	1	1	1	1	1	1	1	1	1
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	205	516	61	156	424	190	475	499	125	513	487	135
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.37	0.37	0.37	0.37	0.37	0.37	0.34	0.34	0.34	0.34	0.34	0.34
Ln Grp Delay, s/veh	8.3	0.0	0.0	8.7	0.0	0.0	10.1	0.0	8.2	10.4	0.0	8.6
Ln Grp LOS	A			A			B		A	B		A
Approach Vol, veh/h		382			414			277			408	
Approach Delay, s/veh		8.3			8.7			8.5			9.2	
Approach LOS		A			A			A			A	
Timer:		1	2	3	4	5	6	7	8			
Assigned Phs			2		4		6		8			
Case No			6.0		8.0		6.0		8.0			
Phs Duration (G+Y+Rc), s			15.4		16.4		15.4		16.4			
Change Period (Y+Rc), s			4.5		4.5		4.5		4.5			
Max Green (Gmax), s			18.0		18.0		18.0		18.0			
Max Allow Headway (MAH), s			5.2		5.6		5.2		5.6			
Max Q Clear (g_c+I1), s			6.9		7.2		8.1		8.0			
Green Ext Time (g_e), s			3.1		4.1		2.9		3.9			
Prob of Phs Call (p_c)			1.00		1.00		1.00		1.00			
Prob of Max Out (p_x)			0.32		0.50		0.40		0.56			
Left-Turn Movement Data												
Assigned Mvmt			5		7		1		3			
Mvmt Sat Flow, veh/h			1109		191		1157		85			
Through Movement Data												
Assigned Mvmt			2		4		6		8			
Mvmt Sat Flow, veh/h			1454		1378		1419		1133			
Right-Turn Movement Data												
Assigned Mvmt			12		14		16		18			
Mvmt Sat Flow, veh/h			363		163		392		509			
Left Lane Group Data												
Assigned Mvmt		0	5	0	7	0	1	0	3			
Lane Assignment					L+T+R				L+T+R			

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
Existing (PM)

Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	47	0	382	0	131	0	414
Grp Sat Flow (s), veh/h/ln	0	1109	0	1732	0	1157	0	1727
Q Serve Time (g_s), s	0.0	1.1	0.0	0.0	0.0	3.1	0.0	0.4
Cycle Q Clear Time (g_c), s	0.0	4.9	0.0	5.2	0.0	6.1	0.0	6.0
Perm LT Sat Flow (s_l), veh/h/ln	0	1109	0	1024	0	1157	0	1083
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	1864	0	0	0	1872
Perm LT Eff Green (g_p), s	0.0	10.9	0.0	11.9	0.0	10.9	0.0	11.9
Perm LT Serve Time (g_u), s	0.0	7.2	0.0	5.9	0.0	7.9	0.0	6.8
Perm LT Q Serve Time (g_ps), s	0.0	1.1	0.0	0.0	0.0	3.1	0.0	0.4
Time to First Blk (g_f), s	0.0	0.0	0.0	4.4	0.0	0.0	0.0	5.6
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	4.4	0.0	0.0	0.0	5.6
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	0.18	0.00	1.00	0.00	0.10
Lane Grp Cap (c), veh/h	0	475	0	782	0	513	0	770
V/C Ratio (X)	0.00	0.10	0.00	0.49	0.00	0.26	0.00	0.54
Avail Cap (c_a), veh/h	0	720	0	1087	0	769	0	1088
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	10.0	0.0	7.9	0.0	10.2	0.0	8.1
Incr Delay (d2), s/veh	0.0	0.1	0.0	0.5	0.0	0.3	0.0	0.6
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	10.1	0.0	8.3	0.0	10.4	0.0	8.7
1st-Term Q (Q1), veh/ln	0.0	0.3	0.0	2.5	0.0	0.9	0.0	2.9
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.3	0.0	2.6	0.0	1.0	0.0	3.0
%ile Storage Ratio (RQ%)	0.00	0.08	0.00	0.12	0.00	0.25	0.00	0.10
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Middle Lane Group Data</b>								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment								
Lanes in Grp	0	0	0	0	0	0	0	0
Grp Vol (v), veh/h	0	0	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	0	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	0	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	0	0	0	0	0	0	0
Upstream Filter (I)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
Existing (PM)

2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Right Lane Group Data</b>								
Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R				T+R			
Lanes in Grp	0	1	0	0	0	1	0	0
Grp Vol (v), veh/h	0	230	0	0	0	277	0	0
Grp Sat Flow (s), veh/h/ln	0	1817	0	0	0	1812	0	0
Q Serve Time (g_s), s	0.0	3.0	0.0	0.0	0.0	3.8	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	3.0	0.0	0.0	0.0	3.8	0.0	0.0
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.20	0.00	0.09	0.00	0.22	0.00	0.29
Lane Grp Cap (c), veh/h	0	624	0	0	0	622	0	0
V/C Ratio (X)	0.00	0.37	0.00	0.00	0.00	0.45	0.00	0.00
Avail Cap (c_a), veh/h	0	1026	0	0	0	1023	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	7.9	0.0	0.0	0.0	8.1	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.4	0.0	0.0	0.0	0.5	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	8.2	0.0	0.0	0.0	8.6	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	1.5	0.0	0.0	0.0	1.8	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	1.5	0.0	0.0	0.0	1.9	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.07	0.00	0.00	0.00	0.10	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Intersection Summary</b>								
HCM 2010 Ctrl Delay	8.7							
HCM 2010 LOS	A							

# LANE SUMMARY

## Site: 1 [Bernard and Haley-AM Peak Hour]

Bernard Street/Haley Street  
Existing Traffic Volumes-AM Peak Hour  
Roundabout

Lane Use and Performance													
	Demand Total veh/h	Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Veh	Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Haley Street													
Lane 1 <sup>d</sup>	257	2.7	940	0.273	100	6.6	LOS A	1.3	33.2	Full	350	0.0	0.0
Approach	257	2.7		0.273		6.6	LOS A	1.3	33.2				
East: WB Bernard Street													
Lane 1 <sup>d</sup>	270	2.7	1015	0.266	100	6.2	LOS A	1.3	33.1	Full	480	0.0	0.0
Approach	270	2.7		0.266		6.2	LOS A	1.3	33.1				
North: SB Haley Street													
Lane 1 <sup>d</sup>	429	2.7	1052	0.408	100	7.8	LOS A	2.3	59.5	Full	335	0.0	0.0
Approach	429	2.7		0.408		7.8	LOS A	2.3	59.5				
West: EB Bernard Street													
Lane 1 <sup>d</sup>	246	2.7	881	0.279	100	7.1	LOS A	1.3	33.2	Full	390	0.0	0.0
Approach	246	2.7		0.279		7.1	LOS A	1.3	33.2				
Intersection	1201	2.7		0.408		7.0	LOS A	2.3	59.5				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.

LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: US HCM 6.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

<sup>d</sup> Dominant lane on roundabout approach

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# LANE SUMMARY

## Site: 1 [Bernard and Haley-Mid Day Peak Hour]

Bernard Street/Haley Street  
Existing Traffic Volumes-Mid Day Peak Hour  
Roundabout

Lane Use and Performance													
	Demand Total veh/h	Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Veh	Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Haley Street													
Lane 1 <sup>d</sup>	230	1.9	867	0.266	100	7.0	LOS A	1.2	31.2	Full	350	0.0	0.0
Approach	230	1.9		0.266		7.0	LOS A	1.2	31.2				
East: WB Bernard Street													
Lane 1 <sup>d</sup>	360	1.9	1013	0.355	100	7.3	LOS A	1.9	48.1	Full	480	0.0	0.0
Approach	360	1.9		0.355		7.3	LOS A	1.9	48.1				
North: SB Haley Street													
Lane 1 <sup>d</sup>	411	1.9	957	0.429	100	8.7	LOS A	2.4	60.6	Full	335	0.0	0.0
Approach	411	1.9		0.429		8.7	LOS A	2.4	60.6				
West: EB Bernard Street													
Lane 1 <sup>d</sup>	339	1.9	915	0.371	100	8.1	LOS A	1.9	48.4	Full	390	0.0	0.0
Approach	339	1.9		0.371		8.1	LOS A	1.9	48.4				
Intersection	1340	1.9		0.429		7.9	LOS A	2.4	60.6				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.

LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: US HCM 6.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

<sup>d</sup> Dominant lane on roundabout approach

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# LANE SUMMARY

## Site: 1 [Bernard and Haley-PM Peak Hour]

Bernard Street/Haley Street  
Existing Traffic Volumes-PM Peak Hour  
Roundabout

Lane Use and Performance													
	Demand Total veh/h	Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Veh	Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Haley Street													
Lane 1 <sup>d</sup>	278	0.6	841	0.330	100	8.0	LOS A	1.6	40.3	Full	350	0.0	0.0
Approach	278	0.6		0.330		8.0	LOS A	1.6	40.3				
East: WB Bernard Street													
Lane 1 <sup>d</sup>	414	0.6	1007	0.411	100	8.1	LOS A	2.3	58.7	Full	480	0.0	0.0
Approach	414	0.6		0.411		8.1	LOS A	2.3	58.7				
North: SB Haley Street													
Lane 1 <sup>d</sup>	407	0.6	969	0.420	100	8.5	LOS A	2.4	59.3	Full	335	0.0	0.0
Approach	407	0.6		0.420		8.5	LOS A	2.4	59.3				
West: EB Bernard Street													
Lane 1 <sup>d</sup>	382	0.6	922	0.415	100	8.7	LOS A	2.3	56.6	Full	390	0.0	0.0
Approach	382	0.6		0.415		8.7	LOS A	2.3	56.6				
Intersection	1481	0.6		0.420		8.4	LOS A	2.4	59.3				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.

LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: US HCM 6.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

<sup>d</sup> Dominant lane on roundabout approach

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Intersection												
Intersection Delay, s/veh	43											
Intersection LOS	E											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	37	199	49	0	26	168	68	0	59	360	38
Future Vol, veh/h	0	37	199	49	0	26	168	68	0	59	360	38
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	3	3	3	2	3	3	3	2	3	3	3
Mvmt Flow	0	40	216	53	0	28	183	74	0	64	391	41
Number of Lanes	0	0	2	0	0	0	2	1	0	1	1	0
Approach												
	EB				WB				NB			
Opposing Approach	WB				EB				SB			
Opposing Lanes	3				2				2			
Conflicting Approach Left	SB				NB				EB			
Conflicting Lanes Left	2				2				2			
Conflicting Approach Right	NB				SB				WB			
Conflicting Lanes Right	2				2				3			
HCM Control Delay	19.2				16.4				68.4			
HCM LOS	C				C				F			
Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2			
Vol Left, %	100%	0%	27%	0%	24%	0%	0%	100%	0%			
Vol Thru, %	0%	90%	73%	67%	76%	93%	0%	0%	82%			
Vol Right, %	0%	10%	0%	33%	0%	7%	100%	0%	18%			
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop			
Traffic Vol by Lane	59	398	137	149	110	91	61	166	351			
LT Vol	59	0	37	0	26	0	0	166	0			
Through Vol	0	360	100	100	84	84	0	0	288			
RT Vol	0	38	0	49	0	7	61	0	63			
Lane Flow Rate	64	433	148	161	120	99	67	180	382			
Geometry Grp	8	8	8	8	8	8	8	8	8			
Degree of Util (X)	0.173	1	0.407	0.426	0.334	0.271	0.17	0.474	0.935			
Departure Headway (Hd)	9.731	9.146	9.875	9.511	10.043	9.873	9.227	9.449	8.825			
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Cap	368	398	365	378	358	364	388	383	412			
Service Time	7.509	6.924	7.639	7.276	7.804	7.634	6.988	7.192	6.568			
HCM Lane V/C Ratio	0.174	1.088	0.405	0.426	0.335	0.272	0.173	0.47	0.927			
HCM Control Delay	14.5	76.4	19.3	19.2	17.8	16.3	13.9	20.5	59.8			
HCM Lane LOS	B	F	C	C	C	C	B	C	F			
HCM 95th-tile Q	0.6	12.1	1.9	2.1	1.4	1.1	0.6	2.5	10.4			

Intersection				
Intersection Delay, s/veh				
Intersection LOS				
Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	166	288	63
Future Vol, veh/h	0	166	288	63
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	3	3	3
Mvmt Flow	0	180	313	68
Number of Lanes	0	1	1	0
Approach		SB		
Opposing Approach		NB		
Opposing Lanes		2		
Conflicting Approach Left		WB		
Conflicting Lanes Left		3		
Conflicting Approach Right		EB		
Conflicting Lanes Right		2		
HCM Control Delay		47.2		
HCM LOS		E		
Lane				

Intersection												
Intersection Delay, s/veh	54.3											
Intersection LOS	F											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	87	267	49	0	35	256	67	0	75	301	44
Future Vol, veh/h	0	87	267	49	0	35	256	67	0	75	301	44
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	95	290	53	0	38	278	73	0	82	327	48
Number of Lanes	0	0	2	0	0	0	2	1	0	1	1	0
Approach												
	EB				WB				NB			
Opposing Approach	WB				EB				SB			
Opposing Lanes	3				2				2			
Conflicting Approach Left	SB				NB				EB			
Conflicting Lanes Left	2				2				2			
Conflicting Approach Right	NB				SB				WB			
Conflicting Lanes Right	2				2				3			
HCM Control Delay	34				23.4				71.5			
HCM LOS	D				C				F			
Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2			
Vol Left, %	100%	0%	39%	0%	21%	0%	0%	100%	0%			
Vol Thru, %	0%	87%	61%	73%	79%	95%	0%	0%	76%			
Vol Right, %	0%	13%	0%	27%	0%	5%	100%	0%	24%			
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop			
Traffic Vol by Lane	75	345	221	183	163	135	60	284	344			
LT Vol	75	0	87	0	35	0	0	284	0			
Through Vol	0	301	134	134	128	128	0	0	260			
RT Vol	0	44	0	49	0	7	60	0	84			
Lane Flow Rate	82	375	240	198	177	146	66	309	374			
Geometry Grp	8	8	8	8	8	8	8	8	8			
Degree of Util (X)	0.258	1	0.735	0.588	0.552	0.45	0.189	0.919	1			
Departure Headway (Hd)	11.372	10.784	11.045	10.663	11.207	11.065	10.402	10.72	10.05			
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Cap	318	341	326	337	322	325	345	336	359			
Service Time	9.072	8.484	8.827	8.444	8.983	8.841	8.178	8.518	7.849			
HCM Lane V/C Ratio	0.258	1.1	0.736	0.588	0.55	0.449	0.191	0.92	1.042			
HCM Control Delay	18	83.1	39.3	27.7	27	22.6	15.6	64.6	80.4			
HCM Lane LOS	C	F	E	D	D	C	C	F	F			
HCM 95th-tile Q	1	11.2	5.5	3.6	3.1	2.2	0.7	9.2	11.5			

Intersection				
Intersection Delay, s/veh				
Intersection LOS				
Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	284	260	84
Future Vol, veh/h	0	284	260	84
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	309	283	91
Number of Lanes	0	1	1	0
Approach		SB		
Opposing Approach		NB		
Opposing Lanes		2		
Conflicting Approach Left		WB		
Conflicting Lanes Left		3		
Conflicting Approach Right		EB		
Conflicting Lanes Right		2		
HCM Control Delay		73.3		
HCM LOS		F		
Lane				

Intersection												
Intersection Delay, s/veh	53.2											
Intersection LOS	F											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	85	340	44	0	41	258	116	0	89	346	87
Future Vol, veh/h	0	85	340	44	0	41	258	116	0	89	346	87
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	1	1	1	1	1	1	1	1	1	1	1	1
Mvmt Flow	0	92	370	48	0	45	280	126	0	97	376	95
Number of Lanes	0	0	2	0	0	0	2	1	0	1	1	0
Approach												
	EB				WB				NB			
Opposing Approach	WB				EB				SB			
Opposing Lanes	3				2				2			
Conflicting Approach Left	SB				NB				EB			
Conflicting Lanes Left	2				2				2			
Conflicting Approach Right	NB				SB				WB			
Conflicting Lanes Right	2				2				3			
HCM Control Delay	44.2				24.1				72.6			
HCM LOS	E				C				F			
Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2			
Vol Left, %	100%	0%	33%	0%	24%	0%	0%	100%	0%			
Vol Thru, %	0%	80%	67%	79%	76%	92%	0%	0%	78%			
Vol Right, %	0%	20%	0%	21%	0%	8%	100%	0%	22%			
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop			
Traffic Vol by Lane	89	433	255	214	170	141	104	166	352			
LT Vol	89	0	85	0	41	0	0	166	0			
Through Vol	0	346	170	170	129	129	0	0	276			
RT Vol	0	87	0	44	0	12	104	0	76			
Lane Flow Rate	97	471	277	233	185	153	113	180	383			
Geometry Grp	8	8	8	8	8	8	8	8	8			
Degree of Util (X)	0.31	1	0.846	0.69	0.576	0.469	0.328	0.563	1			
Departure Headway (Hd)	11.542	10.903	10.989	10.681	11.228	11.05	10.41	11.224	10.574			
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Cap	313	339	330	340	322	326	345	321	344			
Service Time	9.242	8.603	8.752	8.444	8.999	8.821	8.181	9.019	8.37			
HCM Lane V/C Ratio	0.31	1.389	0.839	0.685	0.575	0.469	0.328	0.561	1.113			
HCM Control Delay	19.3	83.6	52.6	34.3	28.3	23.3	18.2	27.7	82.7			
HCM Lane LOS	C	F	F	D	D	C	C	D	F			
HCM 95th-tile Q	1.3	11.1	7.5	4.9	3.4	2.4	1.4	3.3	11.2			



















Intersection				
Intersection Delay, s/veh				
Intersection LOS				
Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	166	276	76
Future Vol, veh/h	0	166	276	76
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	1	1	1	1
Mvmt Flow	0	180	300	83
Number of Lanes	0	1	1	0
Approach		SB		
Opposing Approach		NB		
Opposing Lanes		2		
Conflicting Approach Left		WB		
Conflicting Lanes Left		3		
Conflicting Approach Right		EB		
Conflicting Lanes Right		2		
HCM Control Delay		65.1		
HCM LOS		F		
Lane				



# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
CUM (AM)

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	37	199	49	26	168	68	59	360	38	166	288	63
Future Volume (veh/h)	37	199	49	26	168	68	59	360	38	166	288	63
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1845	1900	1900	1845	1900	1845	1845	1900	1845	1845	1900
Adj Flow Rate, veh/h	40	216	53	28	183	74	64	391	41	180	313	68
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	150	374	85	136	341	128	512	754	79	476	675	147
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.29	0.29	0.29	0.29	0.29	0.29	0.46	0.46	0.46	0.46	0.46	0.46
Ln Grp Delay, s/veh	11.6	0.0	0.0	11.3	0.0	0.0	9.1	0.0	7.3	11.6	0.0	7.0
Ln Grp LOS	B			B			A		A	B		A
Approach Vol, veh/h		309			285			496			561	
Approach Delay, s/veh		11.6			11.3			7.5			8.5	
Approach LOS		B			B			A			A	
Timer:	1	2	3	4	5	6	7	8				
Assigned Phs		2		4		6		8				
Case No		6.0		8.0		6.0		8.0				
Phs Duration (G+Y+Rc), s		20.8		14.7		20.8		14.7				
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5				
Max Green (Gmax), s		18.0		18.0		18.0		18.0				
Max Allow Headway (MAH), s		5.3		5.5		5.3		5.5				
Max Q Clear (g_c+I1), s		8.9		7.3		13.9		6.9				
Green Ext Time (g_e), s		4.4		2.9		2.4		3.0				
Prob of Phs Call (p_c)		1.00		1.00		1.00		1.00				
Prob of Max Out (p_x)		0.68		0.37		1.00		0.34				
Left-Turn Movement Data												
Assigned Mvmt		5		7		1		3				
Mvmt Sat Flow, veh/h		988		125		943		84				
Through Movement Data												
Assigned Mvmt		2		4		6		8				
Mvmt Sat Flow, veh/h		1642		1301		1469		1185				
Right-Turn Movement Data												
Assigned Mvmt		12		14		16		18				
Mvmt Sat Flow, veh/h		172		295		319		445				
Left Lane Group Data												
Assigned Mvmt		0	5	0	7	0	1	0	3			
Lane Assignment		L+T+R					L+T+R					

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
CUM (AM)

Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	64	0	309	0	180	0	285
Grp Sat Flow (s), veh/h/ln	0	988	0	1721	0	943	0	1715
Q Serve Time (g_s), s	0.0	1.7	0.0	0.4	0.0	5.9	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	6.9	0.0	5.3	0.0	11.9	0.0	4.9
Perm LT Sat Flow (s_l), veh/h/ln	0	988	0	1140	0	943	0	1128
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	1833	0	0	0	1836
Perm LT Eff Green (g_p), s	0.0	16.3	0.0	10.2	0.0	16.3	0.0	10.2
Perm LT Serve Time (g_u), s	0.0	11.1	0.0	5.3	0.0	10.3	0.0	4.9
Perm LT Q Serve Time (g_ps), s	0.0	1.7	0.0	0.4	0.0	5.9	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	4.3	0.0	0.0	0.0	5.0
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	4.3	0.0	0.0	0.0	4.9
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	0.13	0.00	1.00	0.00	0.10
Lane Grp Cap (c), veh/h	0	512	0	609	0	476	0	604
V/C Ratio (X)	0.00	0.13	0.00	0.51	0.00	0.38	0.00	0.47
Avail Cap (c_a), veh/h	0	559	0	972	0	521	0	968
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	9.0	0.0	10.9	0.0	11.1	0.0	10.8
Incr Delay (d2), s/veh	0.0	0.1	0.0	0.7	0.0	0.5	0.0	0.6
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	9.1	0.0	11.6	0.0	11.6	0.0	11.3
1st-Term Q (Q1), veh/ln	0.0	0.5	0.0	2.6	0.0	1.5	0.0	2.4
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.5	0.0	2.7	0.0	1.6	0.0	2.5
%ile Storage Ratio (RQ%)	0.00	0.11	0.00	0.12	0.00	0.41	0.00	0.08
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Middle Lane Group Data</b>								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment								
Lanes in Grp	0	0	0	0	0	0	0	0
Grp Vol (v), veh/h	0	0	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	0	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	0	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	0	0	0	0	0	0	0
Upstream Filter (I)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
CUM (AM)



















2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Right Lane Group Data</b>								
Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R				T+R			
Lanes in Grp	0	1	0	0	0	1	0	0
Grp Vol (v), veh/h	0	432	0	0	0	381	0	0
Grp Sat Flow (s), veh/h/ln	0	1814	0	0	0	1788	0	0
Q Serve Time (g_s), s	0.0	6.0	0.0	0.0	0.0	5.2	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	6.0	0.0	0.0	0.0	5.2	0.0	0.0
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.09	0.00	0.17	0.00	0.18	0.00	0.26
Lane Grp Cap (c), veh/h	0	833	0	0	0	821	0	0
V/C Ratio (X)	0.00	0.52	0.00	0.00	0.00	0.46	0.00	0.00
Avail Cap (c_a), veh/h	0	920	0	0	0	907	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	6.8	0.0	0.0	0.0	6.6	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.5	0.0	0.0	0.0	0.4	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	7.3	0.0	0.0	0.0	7.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	3.0	0.0	0.0	0.0	2.5	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	3.1	0.0	0.0	0.0	2.6	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.15	0.00	0.00	0.00	0.13	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Intersection Summary</b>								
HCM 2010 Ctrl Delay	9.3							
HCM 2010 LOS	A							

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

# CMAQ Roundabouts (Kern County)

CUM Mid-Day

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	87	267	49	35	256	67	75	301	44	284	260	84
Future Volume (veh/h)	87	267	49	35	256	67	75	301	44	284	260	84
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	95	290	53	38	278	73	82	327	48	309	283	91
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	197	420	70	128	458	113	467	697	102	470	593	191
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.34	0.34	0.34	0.34	0.34	0.34	0.44	0.44	0.44	0.44	0.44	0.44
Ln Grp Delay, s/veh	12.8	0.0	0.0	12.0	0.0	0.0	11.4	0.0	8.6	18.1	0.0	8.6
Ln Grp LOS	B			B			B		A	B		A
Approach Vol, veh/h		438			389			457			683	
Approach Delay, s/veh		12.8			12.0			9.1			12.9	
Approach LOS		B			B			A			B	
Timer:		1	2	3	4	5	6	7	8			
Assigned Phs			2		4		6		8			
Case No			6.0		8.0		6.0		8.0			
Phs Duration (G+Y+Rc), s			22.5		18.5		22.5		18.5			
Change Period (Y+Rc), s			4.5		4.5		4.5		4.5			
Max Green (Gmax), s			18.0		18.0		18.0		18.0			
Max Allow Headway (MAH), s			5.2		5.6		5.2		5.6			
Max Q Clear (g_c+I1), s			10.7		10.7		20.0		9.4			
Green Ext Time (g_e), s			3.9		3.3		0.0		3.7			
Prob of Phs Call (p_c)			1.00		1.00		1.00		1.00			
Prob of Max Out (p_x)			0.82		0.81		1.00		0.68			
Left-Turn Movement Data												
Assigned Mvmt			5		7		1		3			
Mvmt Sat Flow, veh/h			1004		265		1003		91			
Through Movement Data												
Assigned Mvmt			2		4		6		8			
Mvmt Sat Flow, veh/h			1588		1230		1351		1341			
Right-Turn Movement Data												
Assigned Mvmt			12		14		16		18			
Mvmt Sat Flow, veh/h			233		206		435		331			
Left Lane Group Data												
Assigned Mvmt		0	5	0	7	0	1	0	3			
Lane Assignment					L+T+R				L+T+R			

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

# CMAQ Roundabouts (Kern County)

CUM Mid-Day

Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	82	0	438	0	309	0	389
Grp Sat Flow (s), veh/h/ln	0	1004	0	1702	0	1003	0	1764
Q Serve Time (g_s), s	0.0	2.6	0.0	1.4	0.0	12.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	8.7	0.0	8.7	0.0	18.0	0.0	7.4
Perm LT Sat Flow (s_l), veh/h/ln	0	1004	0	1046	0	1003	0	1054
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	1843	0	0	0	1854
Perm LT Eff Green (g_p), s	0.0	18.0	0.0	14.0	0.0	18.0	0.0	14.0
Perm LT Serve Time (g_u), s	0.0	11.9	0.0	6.6	0.0	12.0	0.0	5.3
Perm LT Q Serve Time (g_ps), s	0.0	2.6	0.0	1.4	0.0	12.0	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	3.7	0.0	0.0	0.0	6.4
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	3.7	0.0	0.0	0.0	6.4
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	0.22	0.00	1.00	0.00	0.10
Lane Grp Cap (c), veh/h	0	467	0	688	0	470	0	699
V/C Ratio (X)	0.00	0.18	0.00	0.64	0.00	0.66	0.00	0.56
Avail Cap (c_a), veh/h	0	467	0	839	0	470	0	862
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	11.2	0.0	11.7	0.0	14.8	0.0	11.3
Incr Delay (d2), s/veh	0.0	0.2	0.0	1.1	0.0	3.3	0.0	0.7
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	11.4	0.0	12.8	0.0	18.1	0.0	12.0
1st-Term Q (Q1), veh/ln	0.0	0.7	0.0	4.3	0.0	3.4	0.0	3.7
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.2	0.0	0.4	0.0	0.1
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.7	0.0	4.5	0.0	3.9	0.0	3.8
%ile Storage Ratio (RQ%)	0.00	0.17	0.00	0.20	0.00	0.98	0.00	0.12
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Middle Lane Group Data</b>								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment								
Lanes in Grp	0	0	0	0	0	0	0	0
Grp Vol (v), veh/h	0	0	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	0	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	0	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	0	0	0	0	0	0	0
Upstream Filter (I)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

# CMAQ Roundabouts (Kern County)

CUM Mid-Day

2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

### Right Lane Group Data

Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R				T+R			
Lanes in Grp	0	1	0	0	0	1	0	0
Grp Vol (v), veh/h	0	375	0	0	0	374	0	0
Grp Sat Flow (s), veh/h/ln	0	1822	0	0	0	1786	0	0
Q Serve Time (g_s), s	0.0	6.0	0.0	0.0	0.0	6.1	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	6.0	0.0	0.0	0.0	6.1	0.0	0.0
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.13	0.00	0.12	0.00	0.24	0.00	0.19
Lane Grp Cap (c), veh/h	0	800	0	0	0	784	0	0
V/C Ratio (X)	0.00	0.47	0.00	0.00	0.00	0.48	0.00	0.00
Avail Cap (c_a), veh/h	0	800	0	0	0	784	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	8.1	0.0	0.0	0.0	8.2	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.4	0.0	0.0	0.0	0.5	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	8.6	0.0	0.0	0.0	8.6	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	2.9	0.0	0.0	0.0	2.9	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	3.0	0.0	0.0	0.0	3.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.15	0.00	0.00	0.00	0.15	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



















### Intersection Summary

HCM 2010 Ctrl Delay	11.8
HCM 2010 LOS	B

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
CUM (PM)

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	340	44	41	258	116	89	346	87	166	276	76
Future Volume (veh/h)	85	340	44	41	258	116	89	346	87	166	276	76
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1881	1900	1900	1881	1900	1881	1881	1900	1881	1881	1900
Adj Flow Rate, veh/h	92	370	48	45	280	126	97	376	95	180	300	83
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	1	1	1	1	1	1	1	1	1	1	1	1
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	180	494	60	129	432	181	436	611	154	372	598	165
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.37	0.37	0.37	0.37	0.37	0.37	0.42	0.42	0.42	0.42	0.42	0.42
Ln Grp Delay, s/veh	14.1	0.0	0.0	12.5	0.0	0.0	13.0	0.0	11.1	17.2	0.0	9.6
Ln Grp LOS	B			B			B		B	B		A
Approach Vol, veh/h		510			451			568			563	
Approach Delay, s/veh		14.1			12.5			11.5			12.0	
Approach LOS		B			B			B			B	
Timer:		1	2	3	4	5	6	7	8			
Assigned Phs			2		4		6		8			
Case No			6.0		8.0		6.0		8.0			
Phs Duration (G+Y+Rc), s			22.5		20.2		22.5		20.2			
Change Period (Y+Rc), s			4.5		4.5		4.5		4.5			
Max Green (Gmax), s			18.0		18.0		18.0		18.0			
Max Allow Headway (MAH), s			5.3		5.6		5.3		5.6			
Max Q Clear (g_c+I1), s			12.0		12.8		18.7		11.0			
Green Ext Time (g_e), s			3.5		2.9		0.0		3.7			
Prob of Phs Call (p_c)			1.00		1.00		1.00		1.00			
Prob of Max Out (p_x)			0.94		1.00		1.00		0.87			
Left-Turn Movement Data												
Assigned Mvmt			5		7		1		3			
Mvmt Sat Flow, veh/h			1006		219		928		99			
Through Movement Data												
Assigned Mvmt			2		4		6		8			
Mvmt Sat Flow, veh/h			1450		1342		1419		1173			
Right-Turn Movement Data												
Assigned Mvmt			12		14		16		18			
Mvmt Sat Flow, veh/h			366		162		393		493			
Left Lane Group Data												
Assigned Mvmt		0	5	0	7	0	1	0	3			
Lane Assignment					L+T+R				L+T+R			

# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
CUM (PM)

Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	97	0	510	0	180	0	451
Grp Sat Flow (s), veh/h/ln	0	1006	0	1724	0	928	0	1765
Q Serve Time (g_s), s	0.0	3.3	0.0	1.9	0.0	8.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	10.0	0.0	10.8	0.0	16.7	0.0	9.0
Perm LT Sat Flow (s_l), veh/h/ln	0	1006	0	995	0	928	0	984
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	1795	0	0	0	1862
Perm LT Eff Green (g_p), s	0.0	18.0	0.0	15.7	0.0	18.0	0.0	15.7
Perm LT Serve Time (g_u), s	0.0	11.4	0.0	6.8	0.0	9.3	0.0	4.9
Perm LT Q Serve Time (g_ps), s	0.0	3.3	0.0	1.9	0.0	8.0	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	4.3	0.0	0.0	0.0	6.8
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	4.3	0.0	0.0	0.0	6.8
Prop LT Inside Lane (P_L)	0.00	1.00	0.00	0.18	0.00	1.00	0.00	0.10
Lane Grp Cap (c), veh/h	0	436	0	734	0	372	0	742
V/C Ratio (X)	0.00	0.22	0.00	0.70	0.00	0.48	0.00	0.61
Avail Cap (c_a), veh/h	0	436	0	819	0	372	0	830
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	12.7	0.0	11.8	0.0	16.2	0.0	11.4
Incr Delay (d2), s/veh	0.0	0.3	0.0	2.2	0.0	1.0	0.0	1.1
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	13.0	0.0	14.1	0.0	17.2	0.0	12.5
1st-Term Q (Q1), veh/ln	0.0	0.9	0.0	5.2	0.0	2.0	0.0	4.4
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.5	0.0	0.1	0.0	0.2
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.9	0.0	5.7	0.0	2.2	0.0	4.6
%ile Storage Ratio (RQ%)	0.00	0.22	0.00	0.25	0.00	0.54	0.00	0.15
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Middle Lane Group Data</b>								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment								
Lanes in Grp	0	0	0	0	0	0	0	0
Grp Vol (v), veh/h	0	0	0	0	0	0	0	0
Grp Sat Flow (s), veh/h/ln	0	0	0	0	0	0	0	0
Q Serve Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane Grp Cap (c), veh/h	0	0	0	0	0	0	0	0
V/C Ratio (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avail Cap (c_a), veh/h	0	0	0	0	0	0	0	0
Upstream Filter (I)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



# HCM 2010 Signalized Intersection Capacity Analysis

## 1: Bernard Street & Haley Street

CMAQ Roundabouts (Kern County)  
CUM (PM)

2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Right Lane Group Data</b>								
Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment	T+R				T+R			
Lanes in Grp	0	1	0	0	0	1	0	0
Grp Vol (v), veh/h	0	471	0	0	0	383	0	0
Grp Sat Flow (s), veh/h/ln	0	1817	0	0	0	1812	0	0
Q Serve Time (g_s), s	0.0	8.7	0.0	0.0	0.0	6.6	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	8.7	0.0	0.0	0.0	6.6	0.0	0.0
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	0.20	0.00	0.09	0.00	0.22	0.00	0.28
Lane Grp Cap (c), veh/h	0	765	0	0	0	763	0	0
V/C Ratio (X)	0.00	0.62	0.00	0.00	0.00	0.50	0.00	0.00
Avail Cap (c_a), veh/h	0	765	0	0	0	763	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	9.7	0.0	0.0	0.0	9.1	0.0	0.0
Incr Delay (d2), s/veh	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	11.1	0.0	0.0	0.0	9.6	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	4.3	0.0	0.0	0.0	3.3	0.0	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.3	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	4.6	0.0	0.0	0.0	3.4	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	0.22	0.00	0.00	0.00	0.17	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Intersection Summary</b>								
HCM 2010 Ctrl Delay	12.5							
HCM 2010 LOS	B							

# LANE SUMMARY

## Site: 1 [Bernard and Haley Future Volumes-AM Peak Hour]

Bernard Street/Haley Street  
Cumulative Traffic Volumes-AM Peak Hour  
Roundabout

Lane Use and Performance													
	Demand Total veh/h	Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Veh	Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Haley Street													
Lane 1 <sup>d</sup>	508	2.7	842	0.603	100	13.6	LOS B	4.5	115.6	Full	350	0.0	0.0
Approach	508	2.7		0.603		13.6	LOS B	4.5	115.6				
East: WB Bernard Street													
Lane 1 <sup>d</sup>	291	2.7	790	0.368	100	9.0	LOS A	1.8	45.4	Full	480	0.0	0.0
Approach	291	2.7		0.368		9.0	LOS A	1.8	45.4				
North: SB Haley Street													
Lane 1 <sup>d</sup>	574	2.7	1001	0.574	100	11.2	LOS B	4.3	108.9	Full	335	0.0	0.0
Approach	574	2.7		0.574		11.2	LOS B	4.3	108.9				
West: EB Bernard Street													
Lane 1 <sup>d</sup>	317	2.7	769	0.412	100	10.0	LOS A	2.1	54.6	Full	390	0.0	0.0
Approach	317	2.7		0.412		10.0	LOS A	2.1	54.6				
Intersection	1690	2.7		0.603		11.3	LOS B	4.5	115.6				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.

LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: US HCM 6.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

<sup>d</sup> Dominant lane on roundabout approach

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# LANE SUMMARY

## Site: 1 [Bernard and Haley Future Volumes-Mid Day Peak Hour]

Bernard Street/Haley Street  
Cumulative Traffic Volumes-Mid Day Peak Hour  
Roundabout

Lane Use and Performance													
	Demand Total veh/h	Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Veh	Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Haley Street													
Lane 1 <sup>d</sup>	457	1.9	659	0.693	100	20.3	LOS C	5.4	136.2	Full	350	0.0	0.0
Approach	457	1.9		0.693		20.3	LOS C	5.4	136.2				
East: WB Bernard Street													
Lane 1 <sup>d</sup>	389	1.9	803	0.485	100	11.1	LOS B	2.9	73.6	Full	480	0.0	0.0
Approach	389	1.9		0.485		11.1	LOS B	2.9	73.6				
North: SB Haley Street													
Lane 1 <sup>d</sup>	683	1.9	896	0.762	100	19.4	LOS B	8.6	218.6	Full	335	0.0	0.0
Approach	683	1.9		0.762		19.4	LOS B	8.6	218.6				
West: EB Bernard Street													
Lane 1 <sup>d</sup>	438	1.9	704	0.622	100	16.3	LOS B	4.4	112.1	Full	390	0.0	0.0
Approach	438	1.9		0.622		16.3	LOS B	4.4	112.1				
Intersection	1966	1.9		0.762		17.3	LOS B	8.6	218.6				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.

LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: US HCM 6.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

<sup>d</sup> Dominant lane on roundabout approach

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# LANE SUMMARY

## Site: 1 [Bernard and Haley Future Volumes-PM Peak Hour]

Bernard Street/Haley Street  
Cumulative Traffic Volumes-PM Peak Hour  
Roundabout

Lane Use and Performance													
	Demand Total veh/h	Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Veh	Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Haley Street													
Lane 1 <sup>d</sup>	549	0.6	725	0.758	100	22.6	LOS C	7.3	182.7	Full	350	0.0	0.0
Approach	549	0.6		0.758		22.6	LOS C	7.3	182.7				
East: WB Bernard Street													
Lane 1 <sup>d</sup>	446	0.6	782	0.571	100	13.4	LOS B	4.0	99.7	Full	480	0.0	0.0
Approach	446	0.6		0.571		13.4	LOS B	4.0	99.7				
North: SB Haley Street													
Lane 1 <sup>d</sup>	545	0.6	902	0.604	100	12.9	LOS B	4.8	120.8	Full	335	0.0	0.0
Approach	545	0.6		0.604		12.9	LOS B	4.8	120.8				
West: EB Bernard Street													
Lane 1 <sup>d</sup>	494	0.6	814	0.606	100	14.0	LOS B	4.6	115.4	Full	390	0.0	0.0
Approach	494	0.6		0.606		14.0	LOS B	4.6	115.4				
Intersection	2035	0.6		0.758		15.9	LOS B	7.3	182.7				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.

LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: US HCM 6.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

<sup>d</sup> Dominant lane on roundabout approach

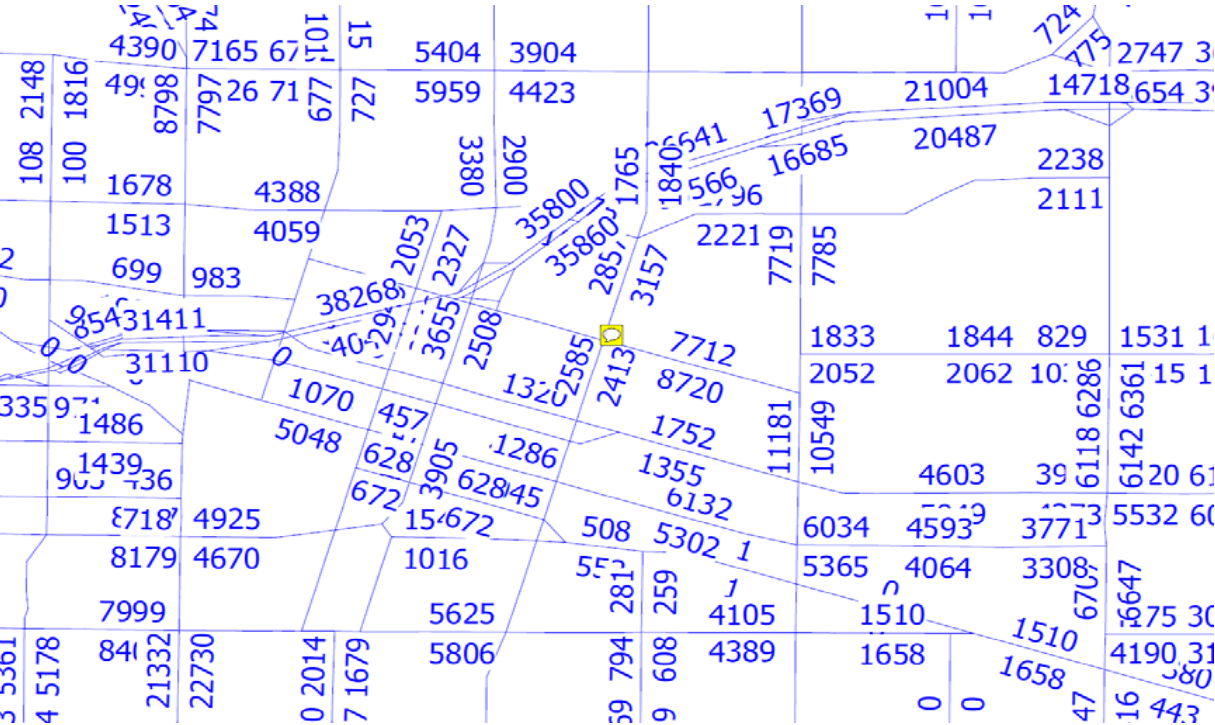
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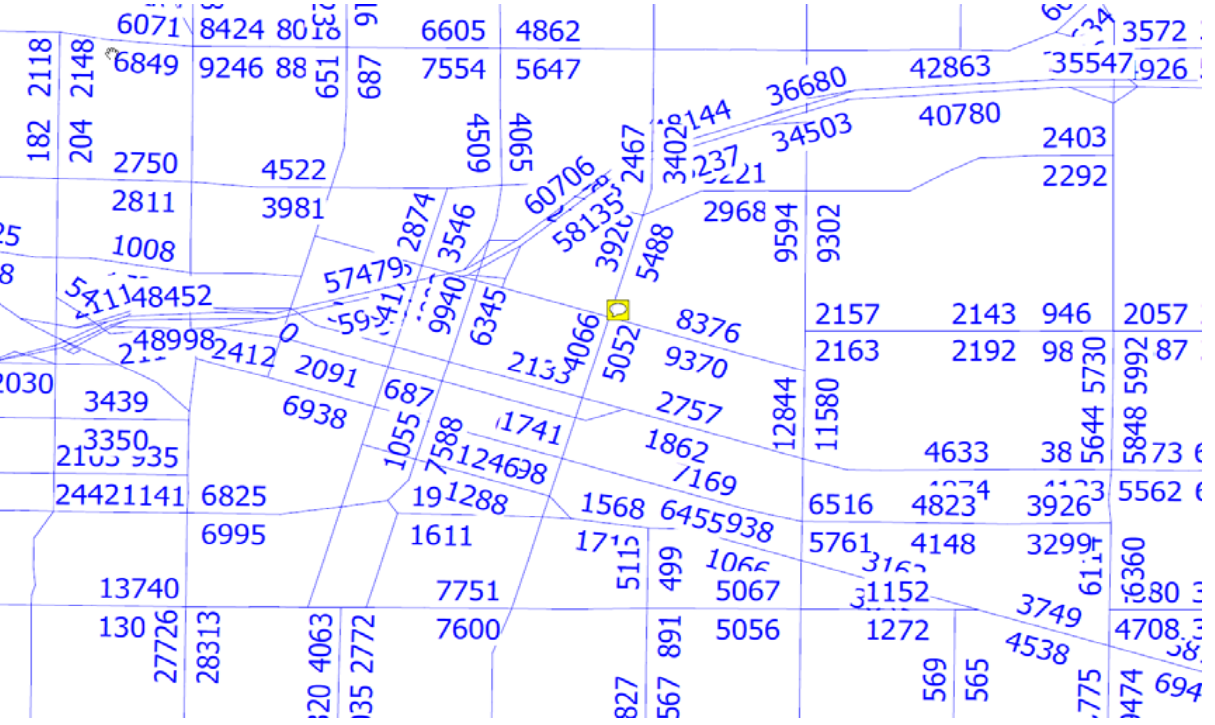
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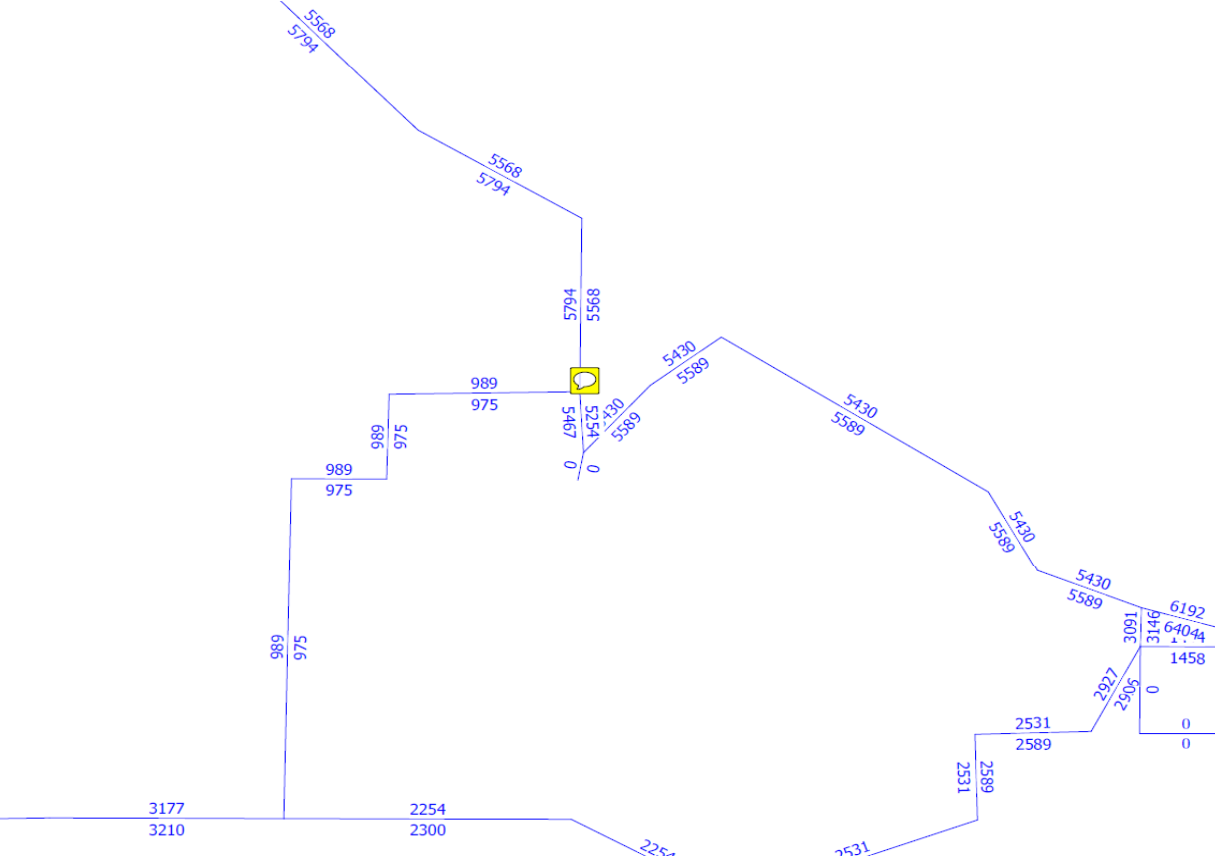
2014 Bakersfield



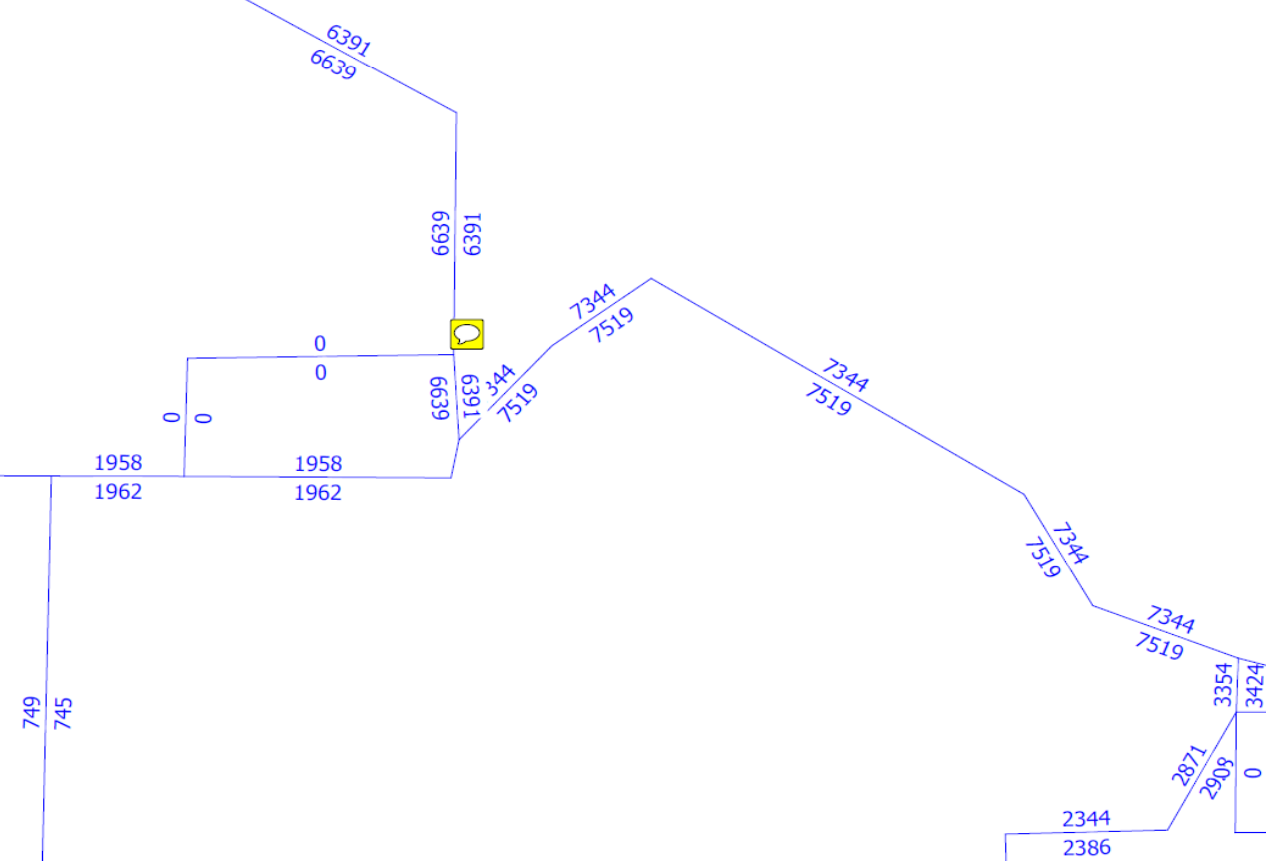
2040 Bakersfield



Tehachapi 2014



Tehachapi 2040





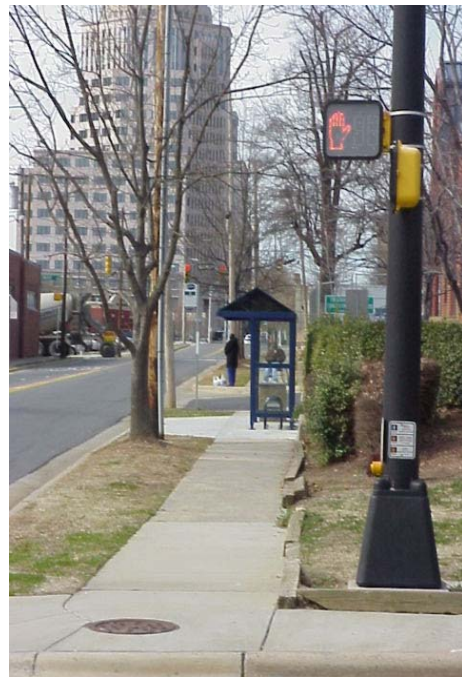


Charlotte Department of Transportation

# PEDESTRIAN & BICYCLE LEVEL OF SERVICE

## METHODOLOGY FOR CROSSINGS AT SIGNALIZED INTERSECTIONS

Updated February 2007



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## INTRODUCTION

The Charlotte Department of Transportation has developed the following methodology to assess the important design features that affect pedestrians and bicyclists crossing signalized intersections. Referred to as Level of Service (LOS), this methodology identifies and evaluates features according to their influence on the comfort and safety of pedestrians and bicyclists. Among the key features identified and rated are crossing distance, roadway space allocation (i.e., crosswalks, bike lanes), corner radius dimension and traffic signal characteristics.

This methodology can be used as a diagnostic tool to assess and improve pedestrian and bicyclist levels of comfort and safety by modifying design and operational features of intersections. The results can be compared with those for traffic levels of service of an intersection and weighed according to user priorities. This methodology is intended to be used to select design and operational features that can help achieve desired levels of service for pedestrians and bicyclists.

## SIGNALIZED INTERSECTION FEATURES AND THEIR RELATIVE IMPORTANCE TO PEDESTRIAN LEVEL OF SERVICE (LOS)

The primary impediments to comfort and safety for pedestrians crossing at signalized intersections are crossing distance and conflicts with turning vehicles. Vehicle volumes and speeds are factors as well, but are tempered by the presence of the traffic signal, its phasing, and/or physical characteristics of the intersection. For example, tight corner radii can slow the speeds of right-turning vehicles, and right and left turn conflicts can be reduced or eliminated by signal phasing, all design factors affecting comfort and safety between pedestrians and vehicles. So although volumes and speeds are not explicitly addressed by this methodology, they are implicitly dealt with.

This approach for assessing pedestrian level of service, therefore, identifies those key elements or features of intersections that enhance or reduce comfort and safety, and then weighs them relative to one another by a point system. Points are assigned to physical and operational features of intersections according to how well they achieve these objectives. These important features are discussed below.

### **Rated Intersection Features**

*Crossing Distance (Table 1)* – As previously mentioned, crossing distance is the primary crossing component or obstacle for pedestrians traveling across intersections and therefore receives the greatest weight in this methodology. The less distance one has to walk to cross a street, the easier and more comfortable it is perceived to be. A crossing equivalent to two or three lanes, for example, rates a minimum LOS of B, exclusive of any other features. By contrast, a crossing of eight lanes or more falls in the LOS F range, exclusive of other features. For wide street crossings, where there is a greater probability that pedestrians might fail to make it across the entire roadway during a signal phase, level of service can be improved noticeably if there is a median wide enough to

serve as a refuge. Slip lanes and raised corner islands can also enhance pedestrian crossings by breaking long continuous distances into shorter, more manageable crossings. Crossing distance is determined based on the number of motor vehicle travel lanes that must be crossed to reach the far side of the intersection. Travel lanes are assumed to be within the range of 10' to 14' in width. If a lane(s) is much wider, one might consider the street crossing as wider than simply the number of delineated travel lanes. For example, the departure leg of an intersection is 20' wide and unmarked. In this case, the departure leg can be considered as two travel lanes to be crossed instead of one.

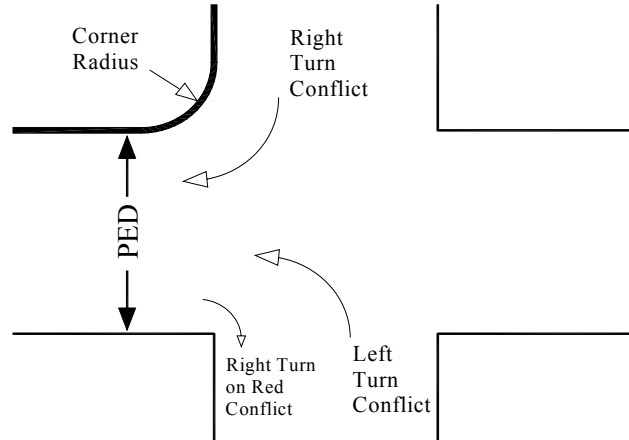
*Signal Phasing & Timing (Table 2)* – This is the most intricate of the design parameters and second most important in terms of points. It is rated according to the type and level of crossing information provided to the pedestrian and whether the signal phasing minimizes, eliminates or exacerbates conflicts between pedestrians and turning vehicles (Figure 1).

The signal phasing feature that rates best for reducing left turn conflicts across the pedestrian path is the Protected Only phase (when turns occur on a green arrow only), provided there are signals that inform pedestrians when they can cross without a conflict with left turning vehicles. Protected turn phases (e.g., green arrow only, green arrow/green ball) without accompanying pedestrian signals expose pedestrians to greater risks by adding an extra phase to the signal cycle that may not be perceptible to pedestrians. This condition, which may entice pedestrians into the street while motorists are turning on the arrow and not expecting to encounter pedestrians crossing, is viewed negatively. Also considered an increased risk, and rated accordingly, are lane arrangements that allow multiple lanes of traffic to turn across pedestrian paths, unless the signal phasing reduces or eliminates the conflict.

As with left turn conflicts, right turn conflicts are assessed according to lane configuration and signal phasing. Points can only be achieved in this category if the pedestrian conflict with turning traffic is eliminated by the signal phasing. Points are taken away if either the signal phasing creates a conflict similar to that discussed above for left turn phasing (overlap) or multiple lanes of traffic are allowed to turn concurrent with pedestrian crossings. Otherwise, no points are awarded or subtracted.

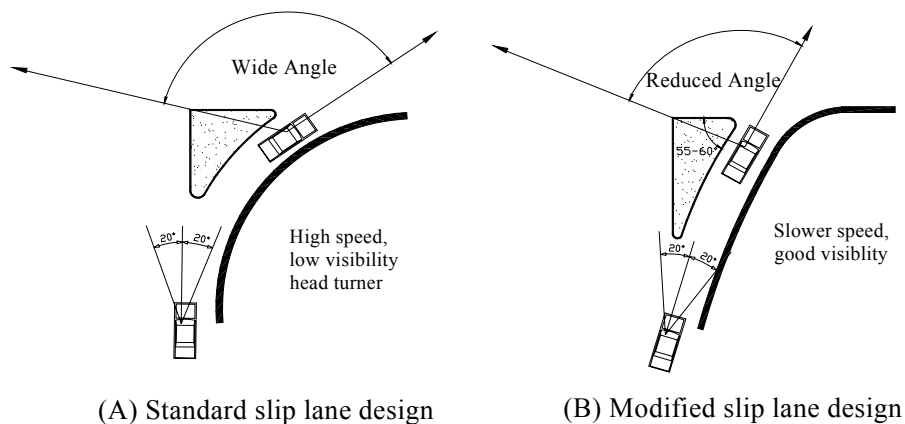
Points can also be attained by the use of pedestrian signals, provided vehicle conflicts are reduced and/or information is given by the signal that shows pedestrians how much time is available for them to cross the street (e.g., countdown signals). Additional points can be obtained within this subcategory by timing pedestrian phases for slower walk speeds, if countdown pedestrian signals are used. Pedestrian phase times based on slower walk speeds without countdown signals are not perceptible to pedestrians, and therefore do not receive extra points.

Figure 1. Pedestrian Crossing Conflicts



*Corner Radius (Table 3)* – Corner radius is rated according to its effect on right-turning vehicle speeds and any increased walking distance for pedestrians. The smaller the radius, the slower the turning speeds around it and the less additional distance to be walked. Radii of 20' or smaller rate best, while large radii (greater than 40') are considered detrimental enough to be assigned negative point values. If slip lanes or raised corner channel islands suitable in size to serve as pedestrian refuge are provided (Figure 2), then points are assigned according to the type of traffic control present (i.e., yield or signal control) and how this control manages the pedestrian-turning vehicle conflict. For simplicity, no distinction is made between corner radius and its effect on vehicle speeds for turns into a single lane or turns into multiple lanes. Also, the effect of intersection angle on vehicle speeds for a given radius is not directly incorporated. Corner radius ranks third for points among the rated intersection features.

Figure 2. Corner Channel Island Designs

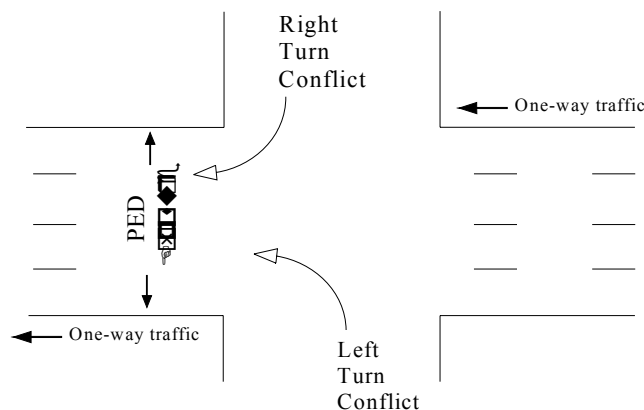


*Right Turns On Red (Table 4)* – Prohibiting right-turns-on-red eliminates a possible conflict between pedestrians and motorists. The Right-Turns-On-Red and Crosswalk (below) features each account for about 5% of the possible points.

*Crosswalk Treatment (Table 5)* - The presence of and design features of crosswalks are both rated. Crosswalks help raise awareness to motorists of the possibility of pedestrians crossing the street. Enhanced crosswalks (e.g., textured/colored pavement or ladder style pavement markings) are more visible than simple transverse markings, and therefore are rated better.

*Adjustment for One-Way Street Crossings (Table 6)* – This parameter accounts for the increased risk to pedestrians caused by their exposure to left and right turning traffic while crossing the departure leg of a one-way street that intersects a two-way street. With this scenario, pedestrians are exposed to left and right turning traffic for the entire crossing distance of the road, instead of just a portion (such as is the case for crossing a two-way street with traffic stopped on the approach lanes by the signal).

Figure 3. Adjustment for One-Way Streets



## **SIGNALIZED INTERSECTION FEATURES AND THEIR RELATIVE IMPORTANCE TO BICYCLE LEVEL OF SERVICE (LOS)**

The major impediments to the comfort and safety of bicyclists are somewhat different than those for pedestrians. Traffic signal features and potential conflicts with turning vehicles are still prominent issues, but crossing distance is less important and is surpassed by the desire for physical space in the roadway apart from automobile traffic. Because bicyclists share space with and travel alongside motor vehicles, the speed of traffic is also a significant factor.

As with the pedestrian level of service methodology, key elements or features of intersections that enhance or reduce comfort and safety are identified and assigned points according to how well they meet the objectives. These important features are discussed below.

## Rated Intersection Features

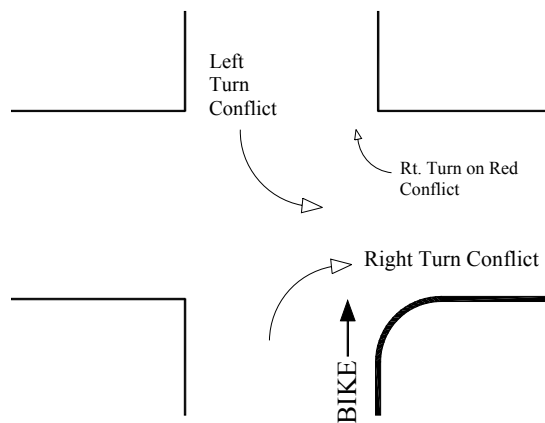
*Bicycle Travel Way & Speed of Adjacent Traffic (Table 8)* – Where bicyclists travel within the roadway and how fast motor vehicle traffic is moving next to them is the most important factor in accessing their comfort and safety.

For streets with moderate to high traffic speeds (30 mph or more), travel space beyond that provided for general traffic is highly desirable. This extra space may be in the form of separate bicycle lanes, or in the form of wide outside travel lanes (13' to 14'). Bicycle lanes rate best and are the preferred treatment. Conditions requiring bicyclists to share travel lanes with motorists rate poorly.

Bike lanes and wide outside lanes, on the other hand, do not provide as much benefit on low speed streets (less than 30 mph) because cyclists can better match the speed of adjacent traffic. Also, low speed streets generally carry low traffic volumes, which many cyclists prefer.

*Signal Features – Left Turn Phasing & Stop Bar Location (Table 9)* – Features that remove potential left turn conflicts from the path of bicyclists and features that place bicyclists before motorists (in space) are rated as desirable. Signal phasing and stop location rate as the second most important bicycle feature.

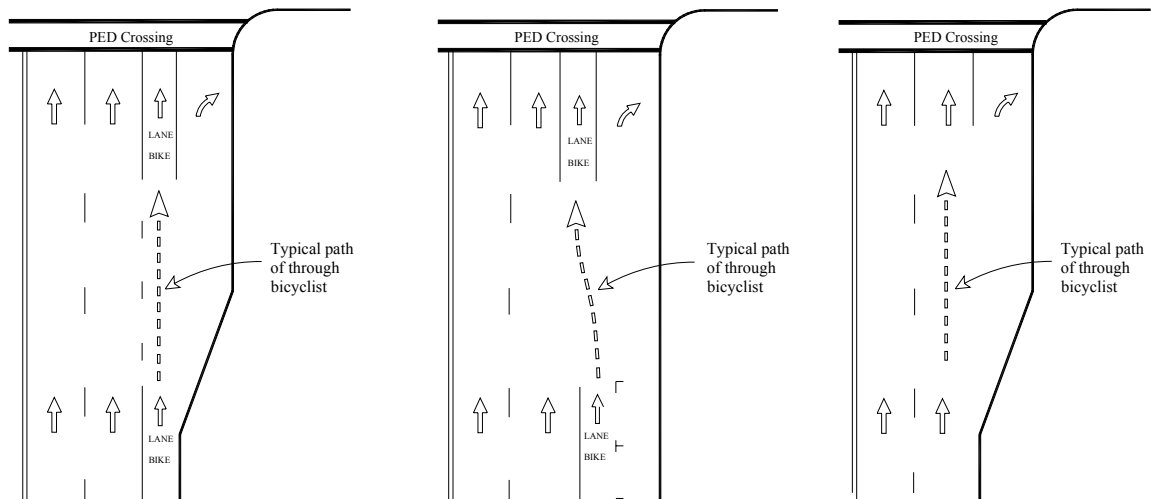
Figure 4. Bicycle Crossing Conflicts



*Right Turn Traffic Conflict (Table 10)* – This parameter addresses the potential conflict involving motorists turning right and bicyclists traveling straight ahead on an intersection approach. The preferred method of resolving this conflict is for bicyclists to ‘take’ the traffic lane if it is shared with traffic, or if there is a separate right turn lane (Figure 5), motorists should merge right in advance of the intersection while bicyclists travel straight-ahead. Points are awarded if there is no right turn conflict with motorists or if there is a bicycle lane that places bicyclists left of a right turn lane. Otherwise, points are

either not awarded at all or they are taken away, depending on whether the bicyclist or motorist is required to merge.

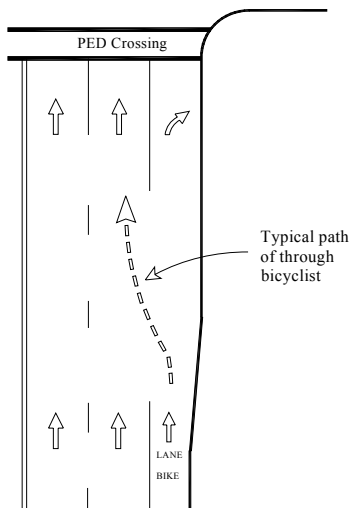
Figure 5. Bike Treatments at Exclusive Right Turn Lanes



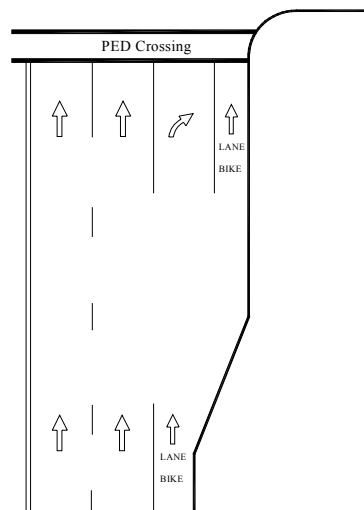
(A) Straight alignment -  
Cyclists travel straight  
and turning motorists  
yield to cyclists  
(BEST CONDITION)

(B) Alignment shift -  
Cyclists merge left  
and turning motorists  
merge right

(C) No bike lane -  
Cyclists share  
lane with motorists



(D) Bike lane ends -  
cyclists shift into motor  
vehicle lane



(E) Bike lane right of  
turn lane  
(BAD CONDITION)

*Right Turns On Red (Table 11)* - This condition creates another conflict between bicyclists and motorists. Bicyclists can easily blend into the background when a motorist is looking to turn right on red because motorists are often looking for larger motor vehicles (Figure 4).

*Crossing Distance (Table 12)* – Wide street crossings increase the risk of exposure to bicyclists from motor vehicle traffic on cross-streets. Signal clearance times (the yellow and all-red signal phase portions) are timed for motor vehicle speeds and not the slower speeds of bicyclists; therefore, the wider the intersection, the greater the likelihood that cyclists will still be crossing when right-of-way changes to the cross-street.

### **Intersection Features Not Rated in the Pedestrian and Bicycle Methodologies**

There are several other features not rated in these methodologies that also affect the comfort and safety of pedestrians and bicyclists and should be considered in intersection design. Among these features are sight lines, street lighting, pavement condition, signing, pedestrian and bike detection, curb extensions, and ADA features such as wheel chair ramps and accessible signals.

### **PEDESTRIAN AND BICYCLE LOS DETERMINATION**

Level of service for an intersection crossing/approach is determined by adding points from Tables 1 through 6 (for Pedestrians) and points from Tables 8 through 12 (for Bicyclists). The accumulation of points is then compared to the points listed in Tables 7 (Pedestrians) and 13 (Bicyclists), which provides the threshold values for levels of service A through F. An overall intersection level of service for either pedestrian or bicycle features can also be determined by adding the total points from each crossing and dividing their sum by the number of intersection crossing legs (e. g., a three leg intersection's point totals would be divided by three). The higher the point total, the better the level of service.

### **SUMMARY**

The level of service methodology is intended to be used to assess the most crucial, especially safety related, factors affecting pedestrians' and bicyclists' crossing signalized intersections. It attempts to identify and compare those design elements that help make intersection crossings safer and pedestrians and bicyclists feel more comfortable. The methodology is not concerned with the quality of the environment away from the intersection crossing, so those elements that make an area more inviting and attractive to pedestrians and bicyclists, such as visual stimuli, convenience, security, and noise are not considered. These other elements and their importance on creating a pedestrian and bicycle friendly environment are addressed through initiatives such as the Urban Street Design Guidelines

The focus of this methodology is on those intersection features that reduce traffic conflicts, minimize crossing distances, slow down traffic speeds and raise user awareness. The methodology assumes that all rated features are adequately designed and

implemented (e.g., signals are timed adequately and pedestrian signals are well placed), so that equivalent comparisons can be made between features. While important to the overall sense of safety and comfort, elements of risk (e.g., traffic volumes) are not directly evaluated in the methodology since design features are the focus and design features can be used to mitigate the effects of risks. Furthermore, design features such as cross-section distance, number and type of travel lanes, and signal-phasing schemes typically reflect varying traffic volumes.

This level of service methodology is expected to be applied in conjunction with the traditional level of service methodology for motor vehicles. The importance or relative weight given to each level of service (for motor vehicles, bicyclists or pedestrians) is expected to vary by intersection, depending on the planned function and context of each intersection.

The following pages provide additional detail of the pedestrian and bicycle level of service methodologies, along with example level of service calculations. As a companion piece to this document, Charlotte DOT has also developed an electronic spreadsheet that can be used to quickly calculate levels of service. The spreadsheet should be used when performing level of service calculations.



## **PEDESTRIAN LEVEL OF SERVICE CALCULATION**

**TABLE 1. PEDESTRIAN LOS: Crossing Distance**

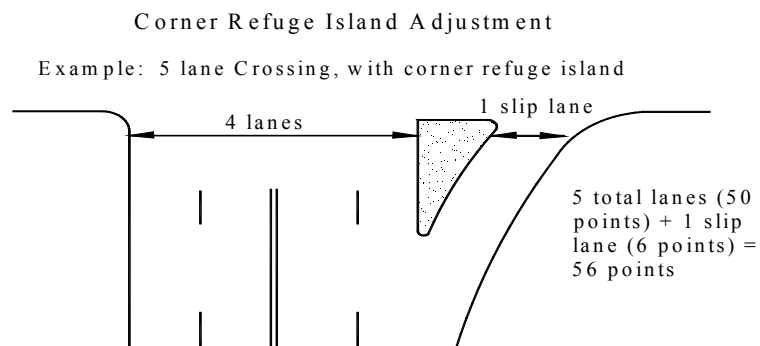
Crossing distance is determined based on the total number of motor vehicle travel lanes that must be crossed to reach the opposite side of the street. The added effect of corner radii on crossing distance is addressed in parameter number 3 (Corner Radius). When the number of travel lanes crossed includes the crossing of corner refuge island lane(s), an adjustment to the points in the table below should be made. This adjustment is described just below the table.

Total Travel Lanes Crossed	Points		
	No Median Refuge (or less than 4')	Median Refuge (4' to 6')	Median Refuge (6' or more)
2 Lanes	80	80	80
3 Lanes	78	78	78
4 Lanes	65	65	68
5 Lanes	50	52	55
6 Lanes	37	40	44
7 Lanes	24	28	33
8 Lanes	8	12	20
9 Lanes	-5	0	10
10 Lanes	-15	-10	0

### **Corner Refuge Island Adjustments:**

- Crossing of corner refuge island lanes is not weighed as heavily as crossing other travel lanes, and therefore the points assigned based on crossing distance in the table above should be adjusted. Six points are assigned for each refuge island lane crossed. Refuge lane points are added to the points assigned for the total crossing distance from Table 1 above.

Example: A crossing of 5 lanes (one of which is a refuge island lane) is adjusted as follows: 50 points (based on 5 lanes crossed) + 6 points (for refuge island lane) = 56 points.



- Adjustments are also made based on how slip lane traffic is controlled at the intersection. If slip lane traffic is under signal control then 5 points are added to the crossing total. If traffic is under Yield control then 3 points are subtracted from the crossing total, and if traffic is uncontrolled (i.e., free flow) then 20 points are subtracted.

**TABLE 2. PEDESTRIAN LOS: Signal Phasing & Timing Features**

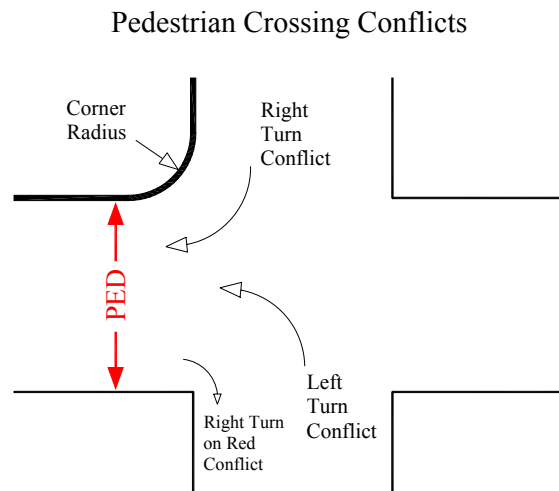


Table 2A Left Turn Conflicts (Left Turns into Pedestrian Crossing Path)	Points
<u>A1. Lefts on GREEN BALL Only (permissive phase - left turns unprotected)</u> <ul style="list-style-type: none"> <li>From SINGLE lane, no pedestrian phase on conflicting crossing</li> <li>From SINGLE lane, <u>with</u> pedestrian phase on conflicting crossing</li> <li>From 2 or more lanes, no pedestrian phase on conflicting crossing</li> <li>From 2 or more lanes, <u>with</u> pedestrian phase on conflicting crossing</li> </ul>	<div style="text-align: center;"> -5  0  -10  -5 </div>
<u>A2. Lefts on GREEN ARROW &amp; GREEN BALL (protected/permissive phase)</u> <ul style="list-style-type: none"> <li>From SINGLE lane, no pedestrian phase on conflicting crossing</li> <li>From SINGLE lane, <u>with</u> pedestrian phase on conflicting crossing</li> </ul>	<div style="text-align: center;"> -5  0 </div>
<u>A3. Lefts on GREEN ARROW Only (protected only phase)</u> <ul style="list-style-type: none"> <li>From SINGLE lane, no pedestrian phase on conflicting crossing</li> <li>From SINGLE lane, <u>with</u> pedestrian phase on conflicting crossing</li> <li>From 2 or more lanes, no pedestrian phase on conflicting crossing</li> <li>From 2 or more lanes, <u>with</u> pedestrian phase on conflicting crossing</li> </ul>	<div style="text-align: center;"> 5  15  0  15 </div>
A4. No Left Turn Conflict (e.g., “T” intersections, one-way streets, exclusive pedestrian phase)	15

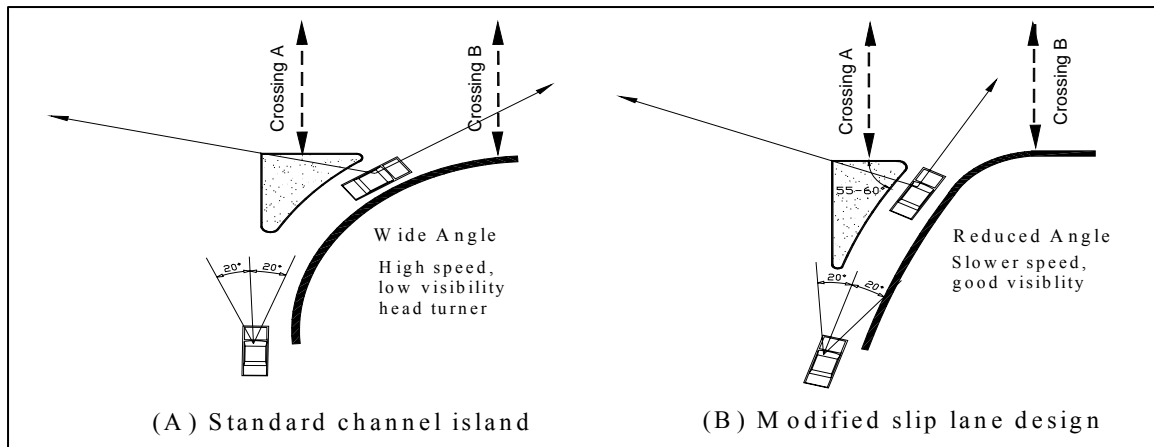
<b>Table 2B</b> <b>Right Turn Conflicts (Right Turns into Pedestrian Crossing Path)</b>	<b>Points</b>
<u>B1. Rights on GREEN BALL Only (permissive phase)</u> <ul style="list-style-type: none"> <li>• From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing</li> <li>• From SHARED Thru-Right lane, <u>with</u> pedestrian phase at crossing</li> <li>• From SINGLE Right lane, no pedestrian phase on conflicting crossing</li> <li>• From SINGLE Right lane, <u>with</u> pedestrian phase on conflicting crossing</li> <li>• From 2 or more Right lanes, no pedestrian phase on conflicting crossing</li> <li>• From 2 or more Right lanes, <u>with</u> pedestrian phase on conflicting crossing</li> </ul>	<div>0</div> <div>0</div> <div>0</div> <div>0</div> <div>-10</div> <div>-7</div>
<u>B2. Rights on GREEN ARROW &amp; GREEN BALL (overlap phase)</u> <ul style="list-style-type: none"> <li>• From RIGHT turn lane(s), no pedestrian phase on conflicting crossing</li> <li>• From RIGHT turn lane(s), <u>with</u> pedestrian phase (no conflict for duration of the Green Arrow)</li> </ul>	<div>0</div> <div>-10</div>
<u>B3. Rights on GREEN ARROW Only (protected phase)</u> <ul style="list-style-type: none"> <li>• From SINGLE Right lane, no pedestrian phase</li> <li>• From SINGLE Right lane, <u>with</u> pedestrian phase – turning traffic held for pedestrian movement, which eliminates turning/crossing conflict</li> <li>• From 2 or more Right lanes, no pedestrian phase</li> <li>• From 2 or more Right lanes, <u>with</u> pedestrian phase – turning traffic held for pedestrian movement, which eliminates turning/crossing conflict</li> </ul>	<div>10</div> <div>-10</div> <div>10</div> <div>-15</div>
B4. No Right Turn Conflict (e.g., “T” intersections, one-way streets, exclusive pedestrian phase)	15

<b>TABLE 2C</b> <b>Pedestrian Phase Signal Display</b>	
C1. No Pedestrian Phase	-5
C2. UPRAISED HAND, WALKING PERSON display	0
C3. UPRAISED HAND, WALKING PERSON display – with LEADING pedestrian phase (pedestrians start crossing seconds before vehicles on the adjacent street)	4
C4. COUNTDOWN display (crossing time is shown) With pedestrian crossing time based on following walk speeds: <div>&gt; 3.5 ft/sec</div> <div>≤ 3.5 ft/sec</div>	<div>5</div> <div>8</div>
C5. LEADING COUNTDOWN display (pedestrians start crossing seconds	

before vehicles on the adjacent street) With pedestrian crossing time based on following walk speeds: <div style="text-align: right;"> <math>&gt; 3.5 \text{ ft/sec}</math>  <math>\leq 3.5 \text{ ft/sec}</math> </div>	8 12
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**TABLE 3. PEDESTRIAN LOS: Corner Radius**

Standard Radius	Points
A. Radius $\leq$ to 20'	10
B. Radius $> 20'$ and $\leq 30'$	5
C. Radius $> 30'$ and $\leq 40'$	0
D. Radius $> 40'$ and $\leq 60'$ (or Equivalent Compound Curve)	-10
E. Radius $> 60'$ (or Equivalent Compound Curve)	-15



CHANNEL ISLAND (in lieu of standard radius)	
F. Painted Channel Island (no curb) <ul style="list-style-type: none"> <li>- Right turns are uncontrolled (free flow)</li> <li>- Right turns made on Yield or Signal Control</li> </ul>	-20 -10
G. Curbed Channel Island (Figure A) <ul style="list-style-type: none"> <li>- Right turns are uncontrolled (free flow)</li> <li>- Right turns on Yield, Green Ball or Green Arrow/Green Ball (&amp; Pedestrian crossing at location B)</li> <li>- Right turns on Yield, Green Ball or Green Arrow/Green Ball (&amp; Pedestrian crossing at location A)</li> <li>- Right turns on Green Arrow Only (&amp; Pedestrian crossing at location B)</li> <li>- Right turns on Green Arrow Only (&amp; Pedestrian crossing at location A)</li> </ul>	-20 -10 0 0 5
H. Curbed Low Speed Design Slip Lane (Figure B) <ul style="list-style-type: none"> <li>- Right turns on Yield, Green Ball or Green Arrow/Green Ball (&amp; Pedestrian crossing at location B)</li> <li>- Right turns on Yield, Green Ball or Green Arrow/Green Ball (&amp; Pedestrian crossing at location A)</li> <li>- Right turns on Green Arrow Only (&amp; Pedestrian crossing at location B)</li> <li>- Right turns on Green Arrow Only (&amp; Pedestrian crossing at location A)</li> </ul>	0 5 5 10

I. No Corner Radius (e.g., “T” intersection)	<b>10</b>
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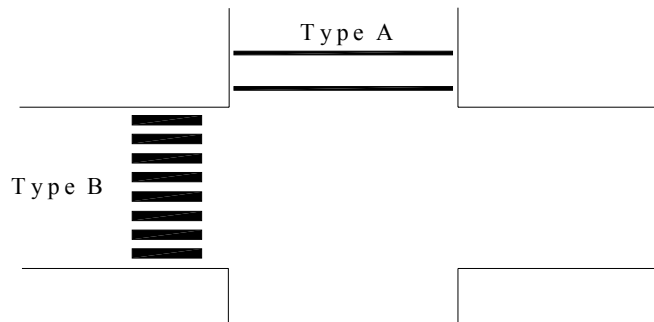
**TABLE 4. PEDESTRIAN LOS: Right Turns On Red**

	<b>Points</b>
Allowed	<b>0</b>
Prohibited (or no conflict because right turns are not permitted/possible)	<b>5</b>

**Table 5. PEDESTRIAN LOS: Crosswalk Treatment**

No designated crosswalk	<b>-5</b>
Painted crosswalk	
- Transverse markings (Type A)	<b>0</b>
- LADDER type markings (Type B)	<b>5</b>
Textured/Colored Pavement	<b>5</b>

**Crosswalk Types**



**Table 6. PEDESTRIAN LOS: Adjustment for One-Way Street Crossings**

<b>Applies only to the departure leg of a one way street with 4 or more lanes that intersects a two-way street. (Figure 3, page 6)</b>	
Conflicting left turns made on:	
• Green Ball Only (with or without pedestrian phase)	<b>-10</b>
• Green Arrow/Green Ball (with or without pedestrian phase)	<b>-10</b>
• Green Arrow Only (without pedestrian phase)	<b>-5</b>
• Green Arrow Only (with pedestrian phase)	<b>-2</b>
• Condition does not apply	<b>0</b>

**TABLE 7. Point Totals and Corresponding PEDESTRIAN Level of Service**

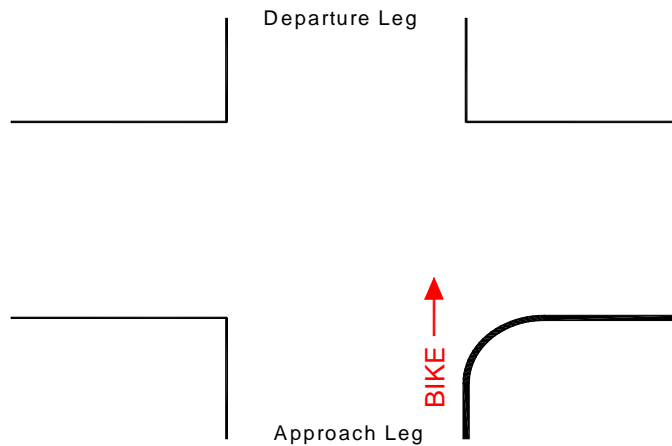
**Points**

**LOS**

93+	A
74 - 92	B
55 - 73	C
37 - 54	D
19 - 36	E
0 - 18	F

### **BICYCLE LEVEL OF SERVICE CALCULATION**

**TABLE 8. BICYCLE LOS: Bicycle Travel Way & Speed of Adjacent Traffic**



Bike Travels in:

<u>(Approach/Departure Legs)</u>	<u>Speed Limit</u>	<u>Points</u>
<ul style="list-style-type: none"> <li><b>Shared Auto Lane to Shared Auto Lane</b> (lanes <math>\leq 12'</math> wide)</li> </ul>	$\geq 40$ mph	5
	30 to 35 mph	30
	$< 30$ mph	50
<ul style="list-style-type: none"> <li><b>Shared Auto Lane to Wide Curb Lane</b> (13' to 14' wide)</li> </ul>	$\geq 40$ mph	20
	30 to 35 mph	40
	$< 30$ mph	55
<ul style="list-style-type: none"> <li><b>Shared Auto Lane to Bike Lane</b></li> </ul>	$\geq 40$ mph	35
	30 to 35 mph	50
	$< 30$ mph	60
<ul style="list-style-type: none"> <li><b>Shared Wide Curb Lane To Shared Auto Lane</b></li> </ul>	$\geq 40$ mph	15
	30 to 35 mph	35
	$< 30$ mph	50
<ul style="list-style-type: none"> <li><b>Shared Wide Curb Lane to Wide Curb Lane</b> (13' to 14' wide)</li> </ul>	$\geq 40$ mph	30
	30 to 35 mph	50

• <b>Shared Wide Curb Lane to Bike Lane</b>	< 30 mph	60
	≥ 40 mph	45
	30 to 35 mph	60
	< 30 mph	70

**TABLE 8 (continued)**

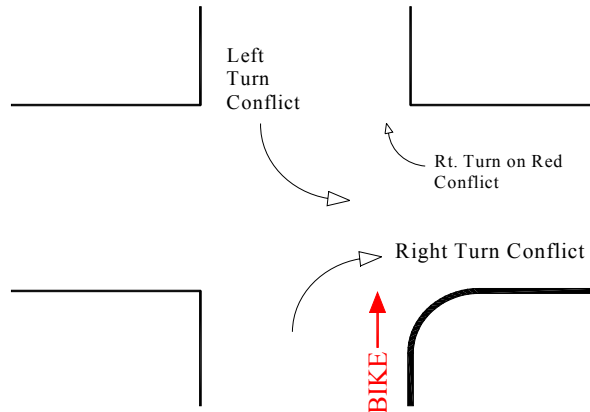
Bike Travels in:

(Approach/Departure Legs)	Speed Limit	Points
• <b>Bike Lane to Shared Auto Lane</b> (lanes ≤ 12' wide)	≥ 40 mph	30
	30 to 35 mph	45
	< 30 mph	55
• <b>Bike Lane to Wide Curb Lane</b> (13' to 14' wide)	≥ 40 mph	40
	30 to 35 mph	55
	< 30 mph	65
• <b>Bike Lane to Bike Lane</b>	≥ 40 mph	60
	30 to 35 mph	70
	< 30 mph	80

**TABLE 9. BICYCLE LOS: Signal Features – Left Turn Phasing & Stop Bar Location**

<b>Vehicular Left Turn Phase</b> – turns opposing cyclists (Figure 4, page 7)	<b>Points</b>
Made on Green Ball Only	<b>0</b>
Made on Green Ball/Green Arrow	<b>5</b>
Made on Green Arrow Only	<b>15</b>
No Left Turn Conflict (e.g., “T” intersection, one-way streets)	<b>15</b>
<b>Stop Bar Location</b>	
Shared stop bar - automobiles & bikes stop at common point	<b>0</b>
Advanced stop bar – bikes stop closer to intersection than automobiles	<b>10</b>

### Bicycle Crossing Conflicts



**TABLE 10. BICYCLE LOS: Right Turn Traffic Conflict**

	Points
<b>No Right Turn Conflict</b> (e.g., “T” intersection, one-way street)	<b>15</b>
<b>No Separate Right Turn Lane</b> (Bike in Shared Lane)	<b>0</b>
<b>Separate Right Turn Lane</b> (Figure 5, page 8)	
Bike lane <b>LEFT</b> of right turn lane (cyclist travels straight ahead and motorist merges right) – see Figure 5A	<b>10</b>
Curb lane <b>drops</b> as right turn lane, with bike lane left of turn lane (cyclist merges left, motorist merges right) – see Figure 5B	<b>5</b>
No bike lane (cyclist travels straight ahead and motorist merges right) – see Figure 5C	<b>0</b>
Curb lane drops as right turn lane, no bike lane at intersection (cyclist merges left, motorist merges right) – see Figure 5D	<b>0</b>
Bike lane <b>RIGHT</b> of right turn lane – see Figure 5E	<b>-20</b>

**TABLE 11. BICYCLE LOS: Right Turns On Red**

Allowed	<b>0</b>
Prohibited (or no conflict because right turns are not permitted/possible)	<b>5</b>

**TABLE 12. BICYCLE LOS: Intersection Crossing Distance**

≤ 3 motor vehicle travel lanes	<b>0</b>
4 to 5 motor vehicle travel lanes	<b>-5</b>
≥ 6 travel motor vehicle lanes	<b>-10</b>

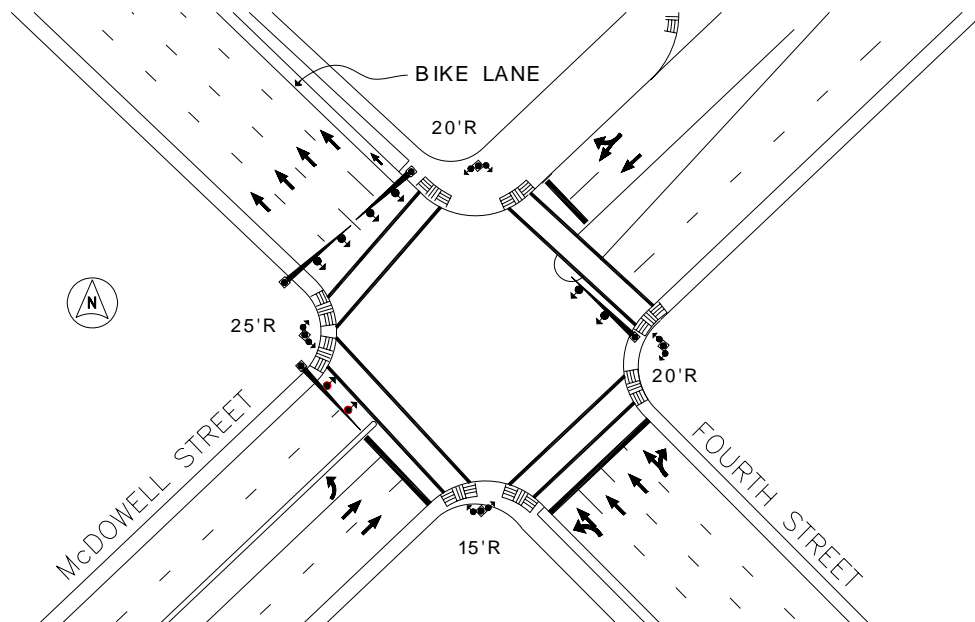
**TABLE 13. Point Totals and Corresponding BICYCLE Level of Service**



Points	LOS
93+	A
74 - 92	B
55 - 73	C
37 - 54	D
19 - 36	E
0 - 18	F

### Intersection Example # 1

Application of the pedestrian and bicycle level of service methodologies for an example intersection is presented in Figures 6 and 7. The intersection evaluated is that of a one-way street (4<sup>th</sup> Street) and a two-way street (McDowell Street) in downtown Charlotte. The sample worksheets in figures 6 and 7 provide information on features relevant to the intersection.



**Figure 6. Example Intersection #1: Pedestrian LOS Calculation**

**Location: 4<sup>th</sup> Street & McDowell Street**

	Crossing of Northbound Approach (McDowell St.)	Crossing of Southbound Approach (McDowell St.)	Crossing of Eastbound Approach (4 <sup>th</sup> St.)	Crossing of Westbound Approach (4 <sup>th</sup> St.)
<b>Pedestrian Crossing Distance</b>	5 Lanes (2' median)	4 Lanes (10' median refuge)	4 Lanes	4 Lanes
Score	<b>50</b>	<b>68</b>	<b>65</b>	<b>65</b>
<b>Signal Features</b>				
Left Turn Conflict (left turns into pedestrian path)	Lefts on Green Ball Only, from a single lane – <u>with</u> pedestrian phase	No Left Turn Conflict - (4 <sup>th</sup> St. one-way)	Lefts on Green Arrow/Green Ball - <u>with</u> pedestrian phasing	No Left Turn Conflict - (4 <sup>th</sup> St. one-way)
Score	<b>0</b>	<b>15</b>	<b>0</b>	<b>15</b>
Right Turn Conflict (right turns into pedestrian path)	No Right Turn Conflict (4 <sup>th</sup> St. one-way)	Right Turns on Green Ball, from a shared thru-right lane - <u>with</u> pedestrian phase	Right Turns on Green Ball, from a shared thru-right lane - <u>with</u> pedestrian phase	No Right Turn Conflict (4 <sup>th</sup> St. one-way)
Score	<b>15</b>	<b>0</b>	<b>0</b>	<b>15</b>
Pedestrian Signal Display	Countdown Display (4 ft/sec)	Countdown Display (4 ft/sec)	Countdown Display (4 ft/sec)	Countdown Display (4 ft/sec)
Score	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>

<b>Corner Radius</b>	25'	20'	20'	15'
Score	<b>5</b>	<b>10</b>	<b>10</b>	<b>10</b>
<b>Right Turns on Red</b>	No Conflict (4 <sup>th</sup> St. one-way)	Prohibited	No Conflict (4 <sup>th</sup> St. one-way)	Allowed
Score	<b>5</b>	<b>5</b>	<b>5</b>	<b>0</b>
<b>Crosswalks</b>	Textured/Colored	Textured/Colored	Textured/Colored	Textured/Colored
Score	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>
<b>Adjustment for One-Way Street Crossings</b>	Two-Way Street (Not Applicable)	Two-Way Street (Not Applicable)	Departure Leg 4 Lanes Wide, with left and right turn conflicts	Multilane One- Way street, no left and right turn conflicts (Not Applicable)
Score	--	--	<b>-10</b>	--
Approach Total	<b>85</b>	<b>108</b>	<b>80</b>	<b>115</b>
Approach LOS	<b>B</b>	<b>A</b>	<b>B</b>	<b>A</b>
<b>Intersection AVG.</b>	<b>97</b>			
<b>INTERSECTION LOS</b>	<b>A</b>			

**Figure 7. Example Intersection #1: Bicycle LOS Calculation**

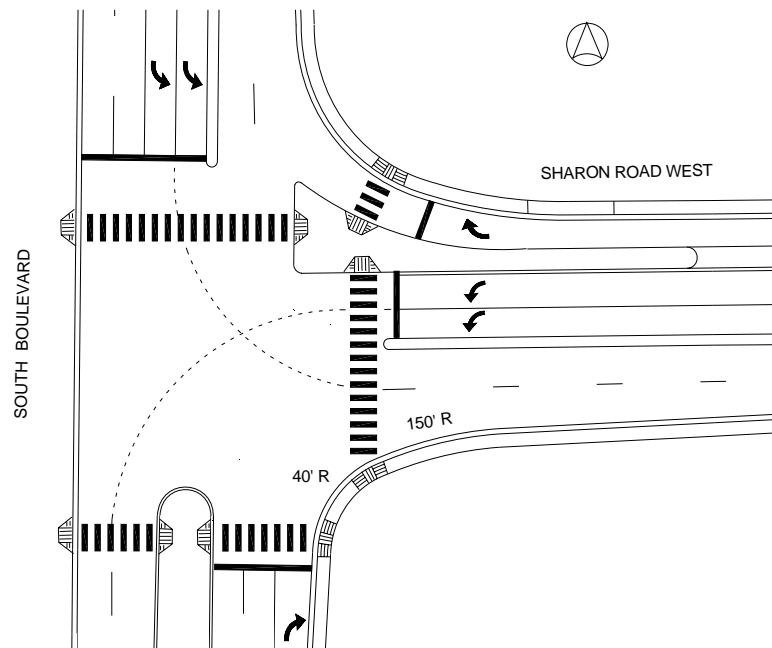
**Location: 4<sup>th</sup> Street & McDowell Street**

	Northbound Approach (McDowell St.)	Southbound Approach (McDowell St.)	Eastbound Approach (4 <sup>th</sup> St.)	Westbound Approach (4 <sup>th</sup> St.)
<b>Bike Travel Way &amp; Speed of Adjacent Traffic</b>	Shared 12' Lane with Motor Vehicles  35 mph	Shared 12' Lane with Motor Vehicles  35 mph	Does not Apply	Shared 12' Lane Transitions to 4' Bike Lane  35 mph
Score	<b>30</b>	<b>30</b>		<b>50</b>
<b>Signal Features</b>				
Opposing Vehicular Left Turn Phase	No Left Turn Conflict	Green Arrow & Green Ball		No Left Turn Conflict
Score	<b>15</b>	<b>5</b>		<b>15</b>
Stop Bar Location	Vehicles & Bikes Stop at Same Point	Vehicles & Bikes Stop at Same Point		Vehicles & Bikes Stop at Same Point
Score	<b>0</b>	<b>0</b>		<b>0</b>
<b>Right Turning Traffic Conflict</b>				
Shared Traffic Lane/Separate Right Turn Traffic Lane	No Right Turn Conflict	Shared Thru-Right lane - no bike lane		Shared Thru-Right Lane - no bike lane on approach

Score	<b>15</b>	<b>0</b>		<b>0</b>
<b>Right Turns On Red</b>	Allowed	No Conflict		Prohibited
Score	<b>0</b>	<b>5</b>		<b>5</b>
<b>Intersection Crossing Distance</b>	4 Travel Lanes	4 Travel Lanes		5 Travel Lanes
Score	<b>-5</b>	<b>-5</b>		<b>-5</b>
Approach Total	<b>55</b>	<b>35</b>		<b>65</b>
Approach LOS	<b>C-</b>	<b>E+</b>		<b>C</b>
<b>Intersection AVG.</b>	<b>52</b>			
<b>Intersection LOS</b>	<b>D+</b>			

### Intersection Example # 2

A second application of the pedestrian level of service methodology is presented in Figure 8. This example illustrates how the methodology should be applied for slip lane or channel island designs. The sample worksheet in figure 8 provides information on features relevant to the intersection.



**Figure 8. Example Intersection #2: Pedestrian LOS Calculation**

**Location: South Boulevard & Sharon Road West**

	Crossing of Northbound Approach (South Blvd..)	Crossing of Southbound Approach (South Blvd..)		Crossing of Westbound Approach (Sharon Rd. West)
<b>Pedestrian Crossing Distance</b>	5 Lanes (12' median refuge)	7 Lanes 6+1 slip lane – under yield control (no median refuge)		5 Lanes 4+1 slip lane – under yield control (no median refuge)
Score	<b>55</b>	<b>27</b>		<b>53</b>
<b>Signal Features</b>				
Left Turn Conflict (left turns into pedestrian path)	Lefts on Green Arrow Only, from 2 lanes – <u>with</u> pedestrian phase	No Left Turn Conflict		Lefts on Green Arrow Only, from 2 lanes – <u>with</u> pedestrian phase
Score	<b>15</b>	<b>15</b>		<b>15</b>
Right Turn Conflict (right turns into pedestrian path)	No Right Turn Conflict	Cross to Corner Channel Island		Right Turns on Green Arrow/Green Ball, from single right turn lane
Score	<b>15</b>	<b>7</b>		<b>0</b>
Pedestrian Signal Display	Countdown Display	Countdown Display		Countdown Display (4 ft/sec)

	(4 ft/sec)	(4 ft/sec)		
Score	<b>5</b>	<b>5</b>		<b>5</b>
<b>Corner Radius</b>	None (T intersection)	Corner Slip Island (crossing point A)		Compound Curve (55' equivalent)
Score	<b>10</b>	<b>5</b>		<b>-10</b>
<b>Right Turns on Red</b>	Allowed	No Conflict		Slip Lane, right turns yield controlled
Score	<b>0</b>	<b>5</b>		<b>0</b>
<b>Crosswalks</b>	Ladder Style	Ladder Style		Ladder Style
Score	<b>5</b>	<b>5</b>		<b>5</b>
<b>Adjustment for One-Way Street Crossings</b>	Not Applicable	Not Applicable		Not Applicable
Score	<b>--</b>	<b>--</b>		<b>--</b>
Approach Total	<b>105</b>	<b>69</b>		<b>68</b>
Approach LOS	<b>A</b>	<b>C</b>		<b>C</b>
<b>Intersection AVG.</b>	<b>81</b>			
<b>INTERSECTION LOS</b>	<b>B</b>			