INTERSECTION CONTROL EVALUATION

EAST BORONDA ROAD AND NORTH SANBORN ROAD

SALINAS, CALIFORNIA

DRAFT

Prepared for:
City of Salinas
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September 2018

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FOR

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Intersection Control Evaluation
East Boronda Road at North Sanborn Road in Salinas, CA

INTRODUCTION

An Intersection Control Evaluation (ICE) was initiated for the intersection of East Boronda Road (Boronda Road) and North Sanborn Road (Sanborn Road) in Salinas, California. The existing, three-legged intersection operates as a side-street stop controlled intersection with a high level of vehicle delay and queuing on the stop controlled Sanborn Road leg of the intersection The high intersection delay and the queue length on the minor road suggest that an eastbound (EB) driver has difficulty turning left onto Boronda road, due to the insufficient gaps between oncoming vehicles. The purpose of this ICE is to evaluate intersection control improvements that will improve intersection operations and safety.

The following intersection control improvement alternatives were evaluated in this ICE Analysis:

1. Traffic signal with existing intersection geometry
2. Roundabout
3. Mini-roundabout

EXISTING CONDITION AND PROPOSED ALTERNATIVES

Existing Conditions

Boronda Road is a primary east-west arterial between Williams Road and US 101. Boronda Road runs in the north-south direction at the intersection of Boronda Road and Sanborn Road with a posted speed limit of 45 mph. Boronda Road has a single through lane in each direction and a left-turn pocket on northbound (NB) approach. Sanborn Road is a primary north-south arterial between Boronda Road and US 101 and it is controlled by a stop sign at the intersection. There are sidewalks on the north and southwest corners of the intersection and they continue along the commercial and residential areas along the southerly side of Boronda Road. The intersection is a part of the Monterey-Salinas Transit route but there are no bus stops within 1000 feet of the intersection.

The existing intersection currently operates as Level of Service (LOS) E and F, and it will continue to worsen as the traffic demand increases with planned development. The intersection evaluation was based on traffic operations for the 2028 design year. The year 2018 was assumed for the baseline “build” condition for a total of 10-year life-cycle duration to determine the B/C Ratio. Refer to **Appendix A** for the list of additional future traffic growth assumptions made to perform the analysis.

Figure 1 on page 2 illustrates the existing intersection control as well as potential design constraints and considerations. The existing design constraints and considerations at Boronda Road and Sanborn Road intersection include:

1. Right of way constraint
2. Boronda Plaza access

3. Gas station and Alisal Shopping Center access
4. Potential extension of Sanborn Road

Figure 1: Design Constraints on Existing Intersection Geometry

Planned Improvements

The intersection of Boronda Road and Sanborn Road is located within the City's West Area Specific Plan (WASP), Central Area Specific Plan (CASP), and East Area Specific Plan (EASP). Future planning of Boronda Road to accommodate the traffic demand of these developments is a four lane-corridor. In addition, future development will extend Sanborn Road to create a four-legged intersection.

Proposed Intersection Control Alternatives

Three alternatives with two different intersection control types were considered in the ICE Analysis for the intersection of Boronda Road and Sanborn Road.

Alternative A: **Traffic Signal with Existing Intersection Geometry**

This alternative replaces the existing side-street stop control with traffic signal control. The geometry will remain the same except for additional crosswalks and sidewalk on north and south legs. Although adding signal control improves operations to LOS B for 2018 and LOS C for 2028 design year, it creates a queue greater than 500 feet long on SB Boronda Road in 2028 peak hours. Queues that are greater than 500 feet will block the driveway of a gated community on north leg of the intersection. The intersection of Boronda Road and Sanborn Road currently meets the signal warrant.

A traffic signal proposed under this alternative will require a significant modification when planned Boronda Road improvement and Sanborn Road Extension are constructed.

Figure 2: Traffic Signal Control

Table 1: Signal Control Operations

	AM			PM		
Design Year	LOS	Delay (s)	95% Queue (ft) (approach)	LO S	Delay (s)	95% Queue (ft) (approach)
2018	B	11.6	350 (SB)	B	13.2	325 (SB)
2028	C	20.2	550 (SB)	C	25.2	525 (SB)

Alternative B: **Roundabout**

This alternative replaces the existing intersection control with a 120-foot inscribed circle diameter (ICD) single lane roundabout. The roundabout will operate at LOS A for both 2018 and 2028 conditions with a maximum delay of 9.8 seconds and a queue of 175 feet. In addition, compared to the traffic signal in Alternative A, the roundabout has additional capacity to accommodate future traffic demand.

The roundabout proposed under this alternative may accommodate the extension of Sanborn Road and delay the need for improvements along Boronda Road. However, the single lane roundabout may not be able to accommodate full build-out of the EASP. Modifications to the roundabout will be required to expand the roundabout to two circulatory lanes.

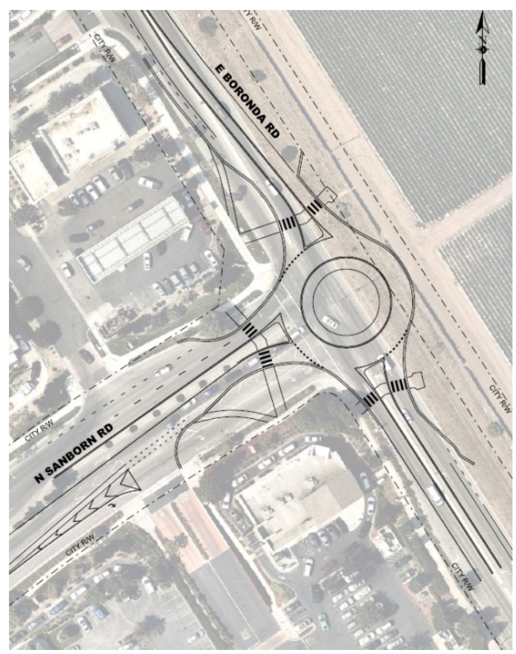


Figure 3: Single Lane Roundabout Control

Table 2: Roundabout Operations

	AM			PM		
Desig n Year	LOS	Delay (s)	95% Queue (ft) (approach)	LO S	Delay (s)	95% Queue (ft) (approach)
2018	A	6.8	100 (SB)	A	7.2	100 (SB)
2028	A	9.3	175 (SB)	A	9.8	150 (SB)

Alternative C: **Mini-Roundabout**

Alternative C includes construction of a mini-roundabout instead of a full-size single lane roundabout as described under Alternative B. A mini-roundabout has the same operational benefits as a roundabout, yet the capital cost of constructing the mini-roundabout is less. Like Alternative B, Alternative C will provide LOS A for both 2018 and 2028 design years.

The mini-roundabout proposed under this alternative will require a significant modification when planned Boronda Road improvement and Sanborn Road Extension are constructed.

Table 3: Mini-Roundabout Operations

	AM			PM		
Design Year	LOS	Delay (s)	95% Queue (ft) (approach)	LOS	Delay (s)	95% Queue (ft) (approach)
2018	A	6.8	100 (SB)	A	7.2	100 (SB)
2028	A	9.3	175 (SB)	A	9.8	150 (SB)

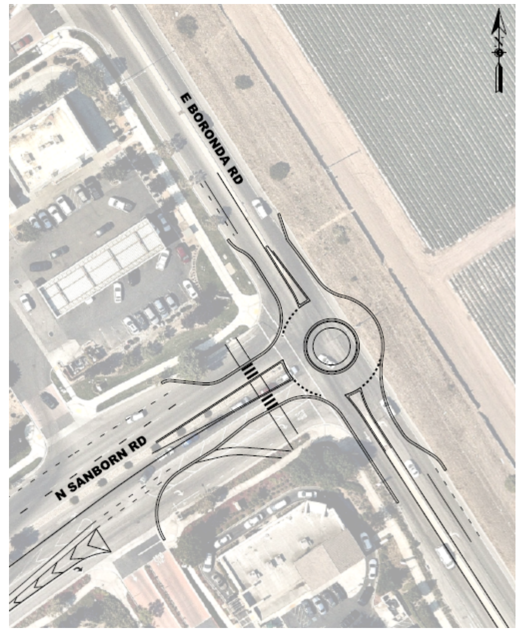


Figure 4: Mini-Roundabout Control

SUMMARY OF KEY PERFORMANCE MEASURES

Five performance metrics are evaluated at the study intersection to calculate the Benefit Cost (B/C) Ratio which measures the expected return on investment for each proposed intersection control. The performance measures used to calculate the ***benefits*** of the proposed improvement compared to the existing condition, or no project alternative are:

- ***Safety Benefit*** (of the proposed intersection control type)
- ***Delay Reduction Benefit*** (of the proposed intersection control type)
- ***Emission Reduction Benefit*** (of the proposed intersection control type)

Performance measures used to calculate the conceptual level ***costs*** of the proposed intersection control improvement compared to the existing condition, or no project alternative are:

- ***Operations and Maintenance (O&M) Cost*** (added costs of the proposed intersection control type)
- ***Initial Capital Cost*** (added costs of the proposed intersection control type)

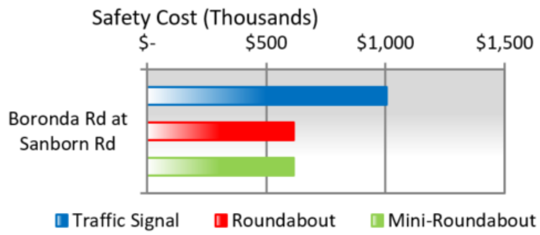
Refer to **Appendix C** for a detailed description of each performance measure and Caltrans Vehicle Operation Cost Parameters that were used in this B/C Analysis.

PERFORMANCE MEASURE SUMMARY

The following figures show the cost of key performance measures for each control types at the intersection of Boronda Road and Sanborn Road assuming 10-years of intersection operations to calculate life-cycle costs. Each intersection control types corresponds to the proposed alternatives discussed on pages 2 and 3.

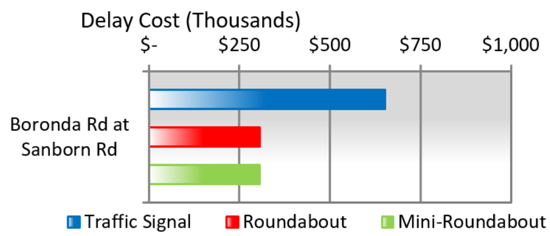
Benefit Performance Measures

Safety



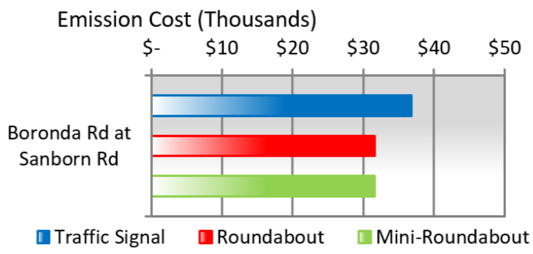
Both roundabout and mini-roundabout are preferable to the traffic signal when comparing the predicted life-cycle cost for safety. The safety cost benefit of the roundabout and mini-roundabout will continue to increase over time when compared to signal control.

Delay



Roundabout and mini-roundabout share similar delay costs. Either of these are preferable to a traffic signal when solely comparing the lowest predicted life-cycle cost for delay. The delay cost benefit of the roundabout will likely increase over time when compared to signal control.

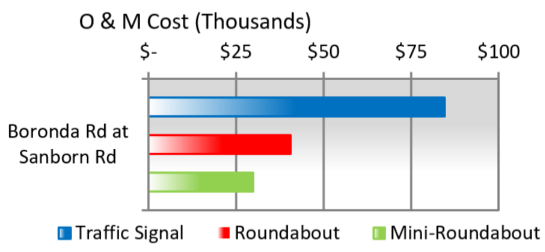
Emissions



Both roundabout and mini-roundabout alternatives are preferable to the traffic signal when based solely on fewer tons per year of mobile source pollutant emissions and the societal cost associated with exposure to these health based pollutant emissions. The figure shows the emission cost of year 2018 based on the average speed through the intersection with each intersection control types.

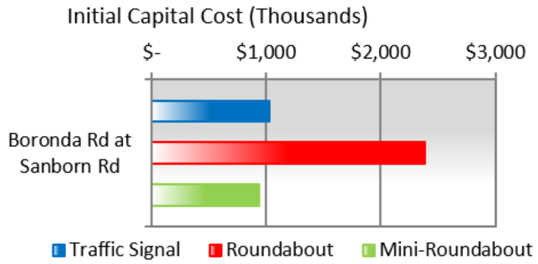
Cost Performance Measures

O&M



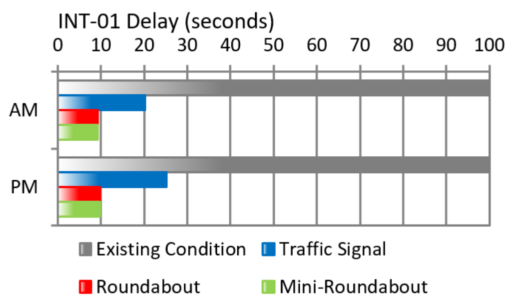
The mini-roundabout is the preferred intersection control type when based solely on lowest expected annual O&M costs.

Initial Capital Costs

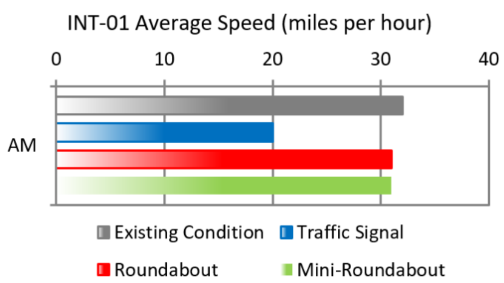


The preferred intersection control type is Alternative C's mini-roundabout when comparing the lowest estimated Initial Capital Costs.

TRAFFIC OPERATIONS SUMMARY



The bar chart to the left compares the peak hour intersection delay for design year between the existing control and each of the proposed intersection control alternatives.



This bar chart illustrates the calculated average speeds through the study intersection used to determine AB 2766 cost effectiveness. The study limit on each leg was based on the largest of the 95% queue lengths of all the intersection control types.

B/C ANALYSIS ON BORONDA ROAD AT SANBORN ROAD

B/C Ratio Scoring

B/C Ratios were calculated for each intersection control alternative. The first set of B/C Ratios in this ICE analysis measures the expected return on investment when the proposed intersection control is compared to the existing side-street stop control.

B/C = 1.00: A B/C Ratio of 1.00 is a neutral rating. This indicates that the return on investment for a proposed intersection control type is equal to the existing intersection control type.

B/C < 1.00: A B/C Ratio less than 1.00 indicates that the existing intersection control will provide a better return on investment when compared to the proposed intersection improvement.

B/C > 1.00: A B/C Ratio greater than 1.00 indicates that the proposed intersection control alternative provides a better return on investment when compared to the existing intersection control type.

B/C Analysis

The B/C Ratios determined for Alternative A and Alternative C are greater than 1.00. This indicates that the traffic signal and mini-roundabout alternatives will provide a better return on investment when compared to the existing side-street stop control at Boronda Road and Sanborn Road.

Table 4 below summarizes the predicted life-cycle cost for the key performance measures in relation to the existing intersection control. Alternative C has the highest B/C Ratio because the mini-roundabout has the same delay benefit as the roundabout but with a lower initial capital cost. Alternative B has the lowest B/C Ratio amongst these three alternatives because of the high initial capital cost to construct a roundabout.

Since the set of calculated B/C ratios that compare each alternative to the existing intersection control only identifies if the proposed intersection control is preferred or not, it is necessary to determine a second set of B/C ratios to identify which of the proposed alternatives provides the most preferred intersection control.

Table 4: Summary of Life-Cycle B/C Analysis when compared to Existing Side-Street Stop Control

LIFE CYCLE BENEFIT/COST ANALYSIS at East Boronda Road and North Sanborn Road				B/C
Alternative A	**ADDED BENEFITS COMPARED TO EXISTING:**			
Traffic Signal with Existing Intersection Geometry	Safety	$	96,279	
	Delay Reduction	$	1,036,045	
	Emission Reduction	$	(5,134)	
	Total Benefits	**$**	**1,127,190**	**1.05**
	ADDED COSTS COMPARED TO EXISTING:			
	O & M	$	49,476	
	Initial Capital	$	1,028,900	
	Total Costs	**$**	**1,078,376**	
Alternative B	**ADDED BENEFITS COMPARED TO EXISTING:**			
Single Lane Roundabout	Safety	$	483,971	
	Delay Reduction	$	1,384,204	
	Emission Reduction	$	-	
	Total Benefits	**$**	**1,868,175**	**0.78**
	ADDED COSTS COMPARED TO EXISTING:			
	O & M	$	5,548	
	Initial Capital	$	2,387,700	
	Total Costs	**$**	**2,393,248**	
Alternative C	**ADDED BENEFITS COMPARED TO EXISTING:**			
Mini- Roundabout	Safety	$	483,971	
	Delay Reduction	$	1,384,204	
	Emission Reduction	$	-	
	Total Benefits	**$**	**1,868,175**	**2.01**
	ADDED COSTS COMPARED TO EXISTING:			
	O & M	$	(5,148)	
	Initial Capital	$	935,850	
	Total Costs	**$**	**930,702**	

Note: The initial capital costs of each alternative include Hot Mix Asphalt Overlay within the project limit to normalize the pavement year.

Table 5 on page 8 shows the second set of B/C Ratios when comparing the proposed alternatives to each other rather than comparing them back to the existing condition. B/C ratio of 0.56 indicates that the traffic signal alternative is preferable when compared to the roundabout alternative. When comparing signal and mini-roundabout, the mini-roundabout alternative has an added benefit of $ 587,080 and a negative added cost, which indicate that the mini-roundabout alternative is preferable than the signal alternative. Refer to **Appendix H** for additional detail of the Sensitivity Analysis, which evaluates the sensitivity of the B/C ratio based on the variability of initial capital costs for each alternative.

Table 5: Alternative Comparison of Intersection Controls

Alternative Comparison of Intersection Controls		Added Benefit Compared to Signal	Added Cost Compared to Signal	B/C
Signal	Roundabout	$ 740,986	$ 1,314,872	0.56
Signal	Mini-Roundabout	$ 587,080	$ 93,050	NA-R*

*NA-R: Cost of Mini-Roundabout is less than cost of Signal.

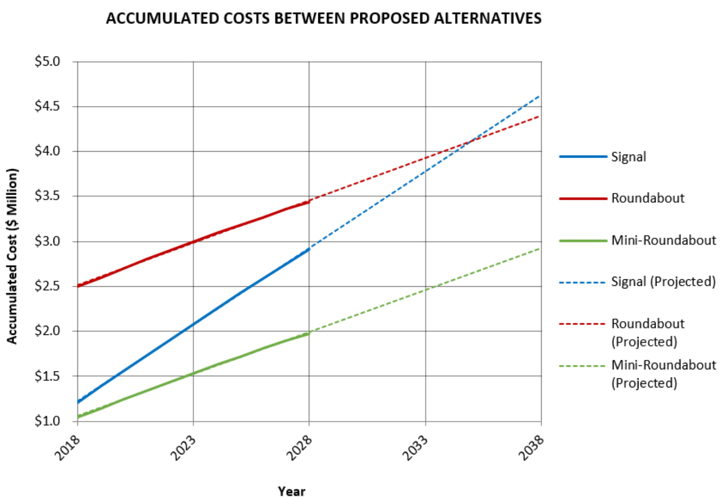


Figure 5: Accumulated Costs Between Proposed Alternatives

Figure 5 shows the accumulated cost of all five performance measures for each proposed alternative. Accumulated costs for the first ten years were used to project the results up to 2038. This figure reflects the B/C ratio results between each alternative since the mini-roundabout alternative has the lowest accumulated cost page8 throughout the entire 20 years. Based on the 20-year projection, traffic signal and roundabout alternatives will have similar accumulated costs around 2035, in which roundabout becomes the second preferred intersection 1control type after mini-roundabout.

RECOMMENDATIONS

The B/C Ratios for Boronda Road at Sanborn Road are 7.42 when compared to a traffic signal with existing intersection geometry, 3.65 when compared to a single lane roundabout, and 9.40 when compared to a mini-roundabout. Since all three alternatives have B/C ratios greater than 1.0, any of these alternatives are cost effective and preferable compared to making no improvements at Boronda Road and Sanborn Road.

Noteworthy performance measures driving the B/C Ratio are *delay* and *capital cost.* All proposed intersection alternatives have an added delay benefit of more than $8,000,000 when compared to the existing side-street stop control. When comparing capital costs, both traffic signal and roundabout have over $1,000,000 while mini-roundabout alternative costs about $930,000.

Operationally, both roundabout and mini-roundabout are viable alternatives to serve forecast traffic with an expected LOS A. The existing side-street stop control is at LOS E and F and will continue to degrade over time as both peak hours reach LOS F by 2028. Alternative A's traffic signal will slightly improve the future year's LOS to a C but the long queues will block up a driveway at north leg of the intersection. There may be other considerations, constraints, and project factors identified in future design evaluations that could affect the feasibility and prioritization of a specific configuration.

The roundabout alternative can include a phasing plan, which considers a range of potential interim roundabout improvements and their incremental operation improvements before constructing the ultimate layout of the roundabout. Considering multiple phases of a roundabout provides a budget framework to balance roundabout size, truck and agricultural vehicle traffic demand, safety, and capital construction costs.

RECOMMENDATIONS FOR FURTHER STUDY

The following recommendations for further study will likely have the greatest effect on the B/C Ratio and the potential return on investment:

- Incorporate existing crash data into the safety analysis
- Incorporate future volumes to evaluate potential phasing of improvements for ultimate condition
- Continue to monitor the impacts to the intersection of shopping center driveways with Sanborn Road, located about 500 feet east of the intersection, including the intersection at Buckhorn Drive and Sanborn Road.

Appendix A

List of Assumptions

LIST OF ASSUMPTIONS

Traffic Data

- **Existing peak-hour turning movement volumes.** Traffic Count Data collected on Tuesday, April 3, 2018 and included in **Appendix D**.
- **Cumulative peak-hour turning movement volumes.** Project trip on East Boronda Road at North Sanborn Road (Intersection 35) in Figure 10b of Salinas WASP Draft TIA was used as the added forecast volume for 2028, instead of the horizon year 2045. This is a conservative assumption to accommodate the future impacts of CASP and EDE which are not shown in the draft TIA. The ten-year design or Phase 1 roundabout, can have an increase in capacity when it is designed as Phase 2 roundabout to meet the demand of an additional leg at the intersection.
- **Existing (2018) ADT on East Boronda Road and North Sanborn Road.** The 2018 ADTs are calculated using the PM peak hour traffic count data.
  - East Boronda Road: 10,000
  - North Sanborn Road: 5,210
- **Design year (2028) ADT.** Calculated by using the PM peak hour volume, provided by Salinas WASP Draft TIA.
  - East Boronda Road: 13,470
  - North Sanborn Road: 7,780
- **Pedestrian counts.** Provided by City of Salinas along with the traffic count data.
- **Bicycle counts.** Not provided.

Appendix B

Conceptual Layouts

Kimley»Horn

E BORONDA ROAD AT N SANBORN ROAD

ALTERNATIVE A: TRAFFIC SIGNAL

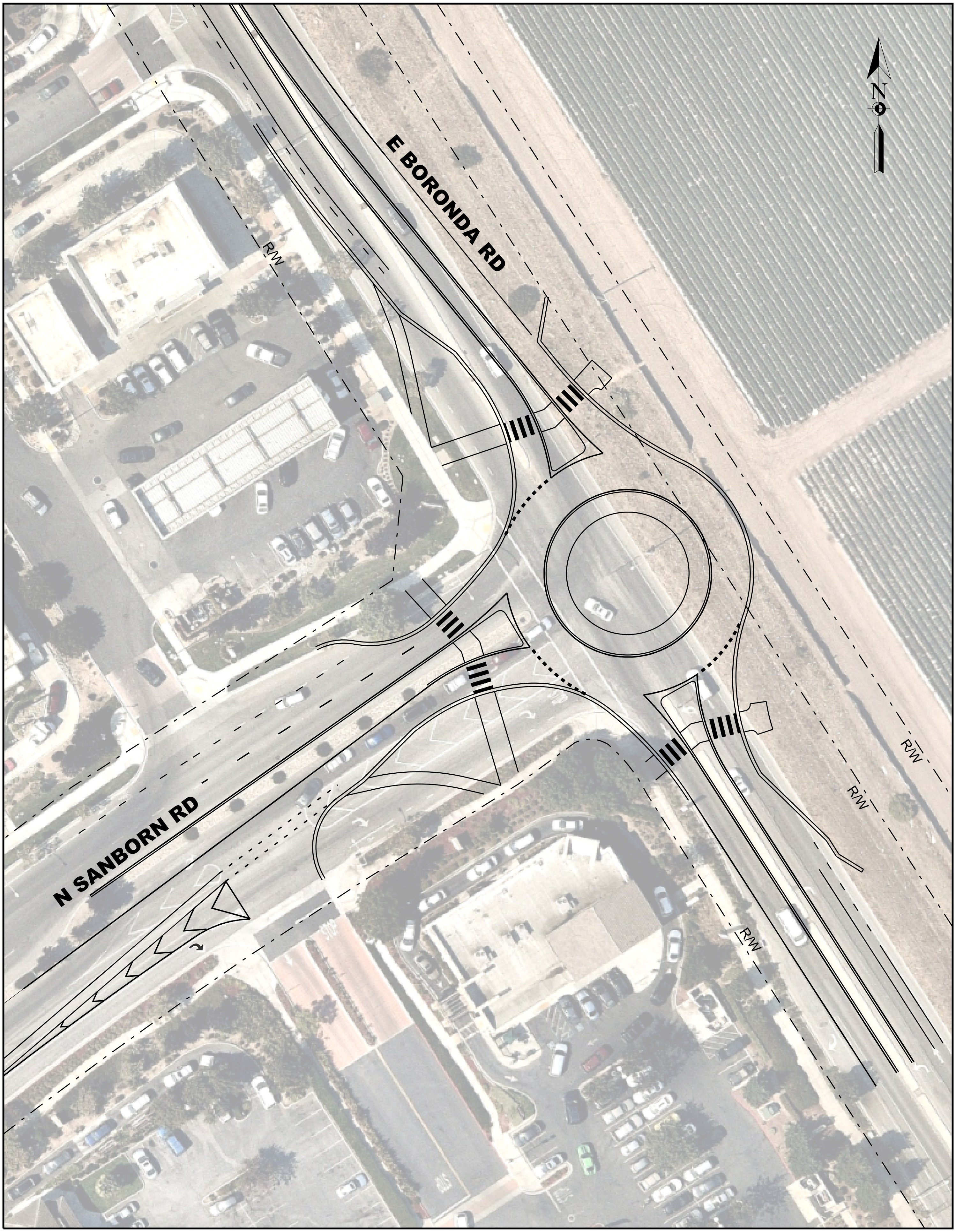
EXHIBIT A

July, 2018

0" 0.5" 1.0"

SCALE

1" = 60'



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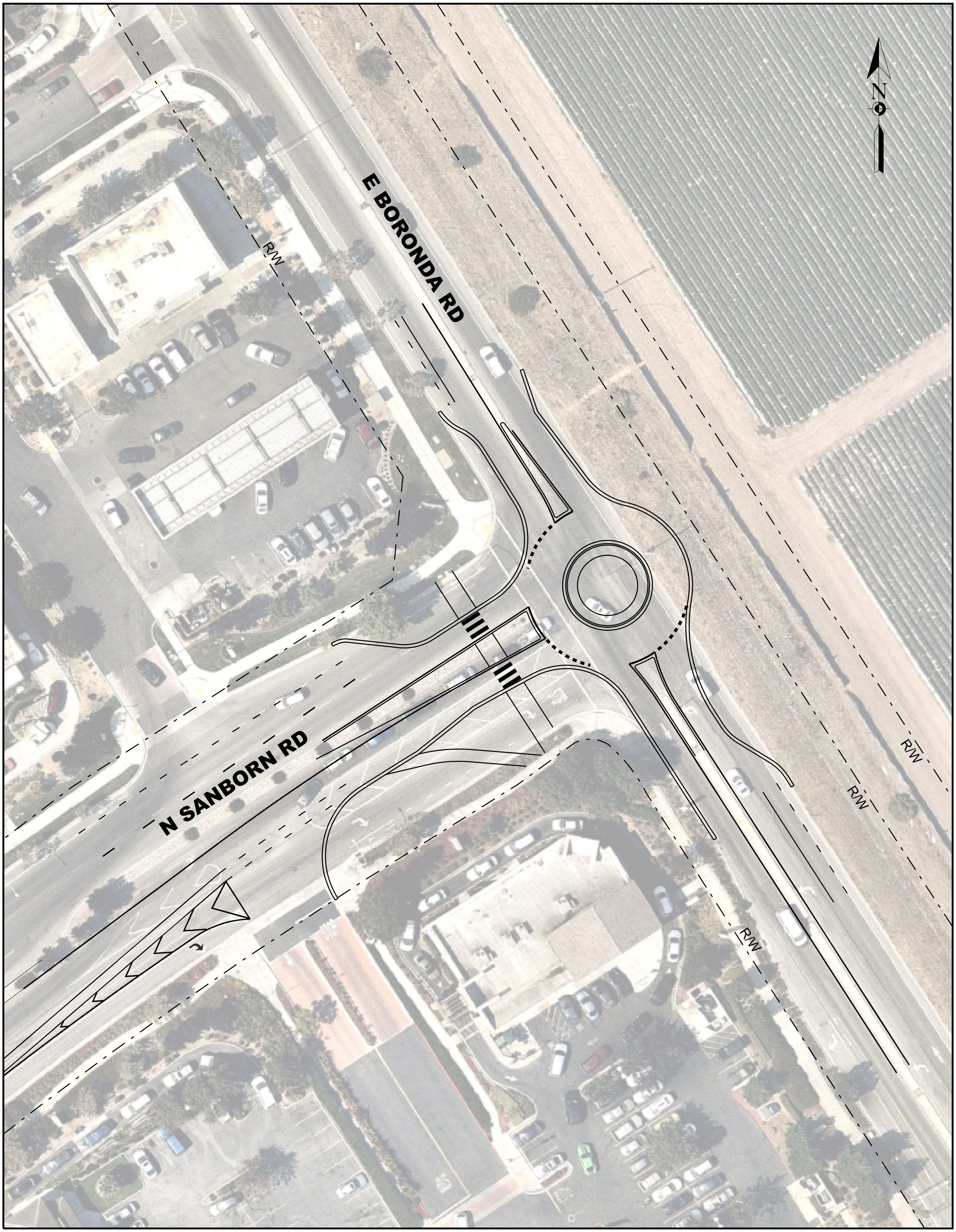
E BORONDA ROAD AT N SANBORN ROAD
ALTERNATIVE B: ROUNDABOUT

EXHIBIT B
July, 2018

0" 0.5" 1.0"
SCALE
1" = 60'



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E BORONDA ROAD AT N SANBORN ROAD

ALTERNATIVE C: MINI-ROUNDABOUT

EXHIBIT C

July, 2018

0" 0.5" 1.0"

SCALE
1" = 60'

Appendix C

Description of Benefit Cost Performance Measures and

Caltrans Vehicle Operation Cost Parameters

BACKGROUND ON BENEFIT COST ANALYSIS

The ICE Analysis is based on the results of a B/C analysis, which is an objective, data-driven calculation that helps inform investment decisions when stakeholders are evaluating intersection control improvements. The calculations identify cost effective improvements considering the full life-cycle of the improvement, typically 20 years.

Five performance metrics are typically evaluated for proposed conceptual control types at each study location to determine the B/C ratio. The metrics include:

- **Safety** – measuring the societal cost associated with the predicted number and severity of collisions.
- **Delay** – measuring the societal cost associated with the number of person-hours of delay.
- **Emissions** – measuring the societal cost associated with the exposure to health based pollutants emitted by motor vehicles.
- **Operations and Maintenance** – measuring common annualized costs associated with operating and maintaining the intersection control.
- **Initial Capital Costs** – measuring the capital costs needed to plan, design, and construct the intersection improvement. The capital costs include construction, capital support, and right of way.

Benefit Performance Measures

The following performance measures are used to calculate the benefit, or cost savings, of the proposed intersection control improvement compared to the existing condition. For each performance measure, the proposed improvement provides a benefit if the calculated life-cycle cost of the proposed improvement is less than the life-cycle cost of the existing condition. The magnitude of the benefit is the difference between the life-cycle cost of the existing condition less the life-cycle cost of the proposed improvement.

Safety

Safety measures the societal cost associated with the predicted number and severity of collisions that may occur for the existing and each proposed intersection control type. The number of predicted collisions was calculated using Highway Safety Manual predictive methods and crash modification factors (CMF). Since CMFs and Safety Performance Functions (SPF) are statistical models based on historical crash data, the safety cost is only a *prediction* of crash severity distribution, and does not perfectly represent the future crash data.

Delay

Delay measures the societal cost associated with the number of person-hours of delay at the intersection during the study period. Consistent with the Caltrans Vehicle Operation Cost Parameters 2016, vehicle occupancy of 1.15 is used to convert delay to person-hours of delay at a value of $18.95 per vehicle-hour of delay, which is the weighted-average of automobile and truck.

Emissions

The emissions performance measure calculates the societal cost associated with exposure to health based pollutants emitted by motor vehicles. Pollutant emissions are running emissions based on the average speed of vehicles traveling through the intersection during the study period. Pollutant emissions evaluated include reactive organic gasses (ROG), nitrogen oxides (NOx), and particulate matter (PM10). The societal cost of emissions is calculated using emission data from the California Air Resource Board (CARB) Methods to Find the Cost-Effectiveness of Funding Air Quality Projects, Table 4 Emission Factors by Speed, April 2013 and cost per ton data from Caltrans Vehicle Operation Cost Parameters 2016 for emissions (Note: VOC is assumed to be synonymous with ROG).

Cost Performance Measures

The following performance measures are used to calculate the added cost of the proposed intersection control improvements compared to the existing control. For each performance measure, the proposed improvements add to the cost of the intersection if the calculated life-cycle cost of the proposed improvement is greater than the life-cycle cost of existing condition. The magnitude of the cost is the difference between the life-cycle cost of the proposed improvement less the life-cycle cost of the existing condition.

Operations and Maintenance (O&M)

The operations and maintenance performance measure incorporates common annualized costs associated with operating and maintaining the proposed type of intersection control. Common costs include signal timing and maintenance, power consumption for signal operations and intersection illumination, landscape maintenance, and pavement rehabilitation. Average annualized costs were used.

Initial Capital Costs

The initial capital costs performance measure estimates the capital costs needed to plan, design, and construct the proposed intersection improvement. The capital costs include construction, capital support, and right of way.

CALIFORNIA DEPARTMENT OF
TRANSPORTATION

Caltrans » Transportation Planning » Planning Offices » Office State Planning - Economic Analysis Branch » **Life-Cycle Benefit-Cost Analysis - Economic Parameters 2016**

Vehicle Operation Cost Parameters (2016 Current Dollar Value)

The Economics Analysis Branch utilizes standard economic valuations for application in benefit-cost analysis. These values are used consistently across the Cal-B/C Framework, which includes the Cal-B/C V6.0 and Cal-B/C Corridor . The values are recommended for use in economic analysis on all modes, including highway, rail and transit projects. The economic values represent statewide averages.

TRAVEL TIME PARAMETER	
Discount Rate	**Percent**
Real (Inflation Adjusted)	4.0
Value of Time	**Dollar Per Person Hour**
Automobile	$ 13.65
Truck	$ 31.40
Auto/Truck Composite (Weighted-Average)	$ 18.95
Transit (in vehicle)	$ 13.65
Transit (out of vehicle)	$ 27.30
Average Vehicle Occupancy Rate	1.15
VEHICLE OPERATION COST PARAMETERS	
Average Fuel Price	**Dollar Per Gallon**
Regular Unleaded (auto)	$ 3.18

Diesel (truck)	$ 3.00
Fuel Price (excluding taxes)	**Dollar Per Gallon**
Regular Unleaded (auto)	$ 2.65
Diesel (truck)	$ 2.40
Non-Fuel Costs	**Dollar Per Mile**
Automobile	$ 0.313
Truck	$ 0.429
ACCIDENT COST PARAMETERS	
Cost of Highway Accident	**Dollar Per Accident**
Fatal Accident	$ 10,800,000
Injury Accident	$ 148,800
Property Damage Only (PDO) Accident	$ 9,700
Average Cost per Accident	$ 185,600
Cost of an Event	**Dollar Per Event**
Cost of a Fatality	$ 9,800,000
Cost of an Injury	**Dollar Per Event**
Level A (Severe)	$ 466,400
Level B (Moderate)	$ 127,000

Level C (Minor)	$ 64,900
Cost of Property Damage	$ 2,700

EMISSION COST PARAMETERS			
Health Cost of Transportation Emission	**Dollar Per U.S. Ton**		
Pollutant	**L.A. South Coast**	**CA Urban Area**	**CA Rural Area**
Carbon Monoxide (CO)	$ 160	$80	$ 75
Nitrogen Oxide (NOx)	$ 63,900	$ 18,700	$ 13,900
Particular Matter (PM10)	$ 523,300	$ 151,100	$ 107,700
Sulfur Oxide (SOx)	$ 196,600	$ 75,500	$ 54,400
Volatile Organic Compounds (VOC)	$ 3,970	$ 1,305	$ 1,025

**The Cal-B/C Framework is setup to evaluate costs and benefits in constant dollars without escalating future values.*
***The Cal-B/C Framework includes a two-percent "uprating" factor, so that subsequent years reflect the increasing values. This approach is consistent with Interagency Working Group on Social Cost of Carbon, United States Government,2016.*

The Cal-B/C Framework, as a standard benefit-cost approach, focuses on estimating travel time savings, vehicle operating cost savings, safety savings and vehicle emissions savings. The Framework offers a simple, practical method for preparing economic evaluations on prospective highway, rail and transit improvement projects. For individuals interested in non-traditional impacts, such as noise and land use, we provide the following links with information on some other impacts from transportation improvements:

- The True Cost of Driving Calculator
- Victoria Transport Policy Institute: Transportation Cost & Benefit Analysis - Techniques, Estimates & Implications

Caltrans is providing this information solely for user consideration and does not endorse the opinions or values provided.

Appendix D

Traffic Volumes

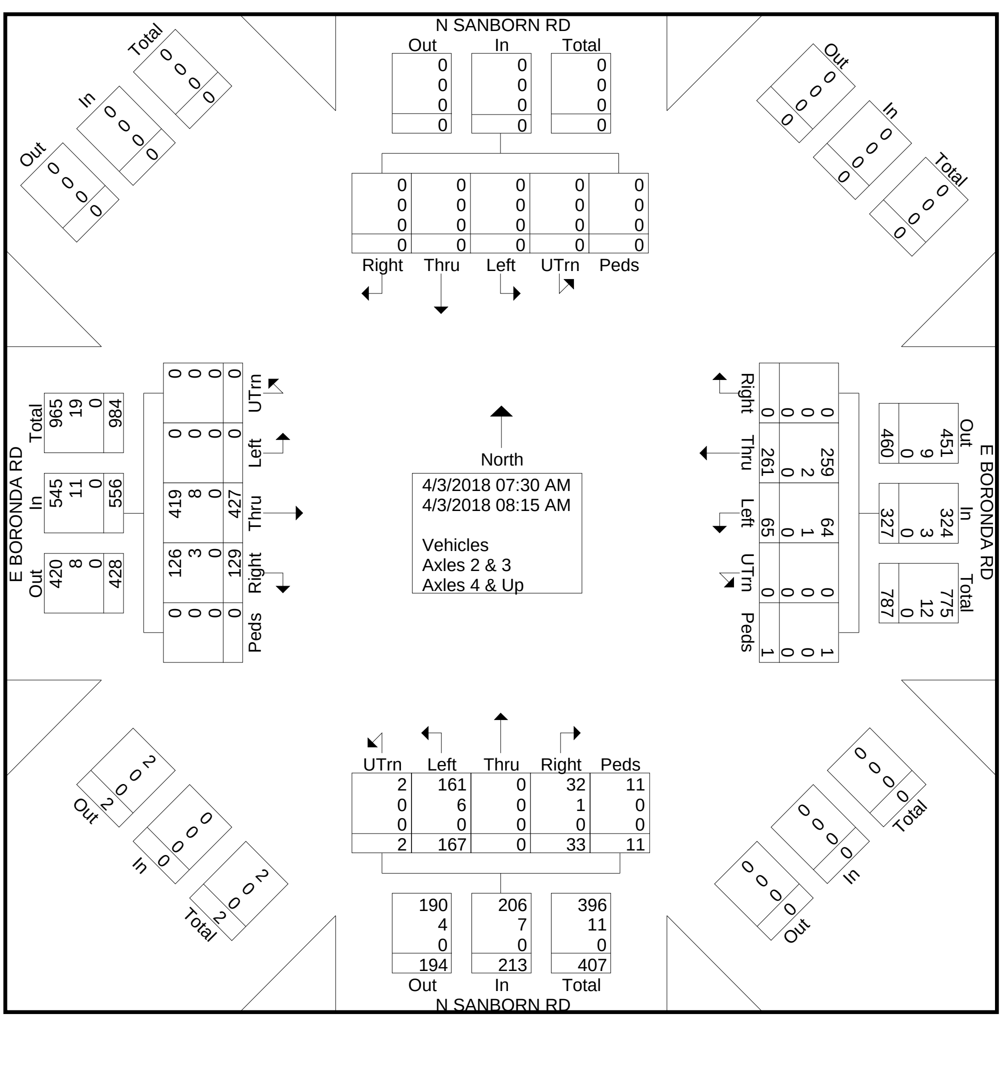
CITY OF SALINAS
TURNING MOVEMENT PROGRAM

E Boronda Rd. @ N Sanborn Rd.
Counted by: Miovision
Weather: Sunny
Hours: 7:30 am to 8:30 am

File Name : Boronda & Sanborn
Site Code :
Start Date : 4/3/2018
Page No : 1

Groups Printed- Vehicles - Axles 2 & 3 - Axles 4 & Up

	N SANBORN RD From North						E BORONDA RD From East						N SANBORN RD From South						E BORONDA RD From West						
Start Time	Right	Thru	Left	UTrn	Peds	App. Total	Right	Thru	Left	UTrn	Peds	App. Total	Right	Thru	Left	UTrn	Peds	App. Total	Right	Thru	Left	UTrn	Peds	App. Total	Int. Total
07:30 AM	0	0	0	0	0	0	0	74	16	0	1	91	13	0	42	0	0	55	19	118	0	0	0	137	283
07:45 AM	0	0	0	0	0	0	0	102	19	0	0	121	9	0	43	1	3	56	42	134	0	0	0	176	353
Total	0	0	0	0	0	0	0	176	35	0	1	212	22	0	85	1	3	111	61	252	0	0	0	313	636
08:00 AM	0	0	0	0	0	0	0	52	19	0	0	71	7	0	32	1	1	41	51	110	0	0	0	161	273
08:15 AM	0	0	0	0	0	0	0	33	11	0	0	44	4	0	50	0	7	61	17	65	0	0	0	82	187
Grand Total	0	0	0	0	0	0	0	261	65	0	1	327	33	0	167	2	11	213	129	427	0	0	0	556	1096
Apprch %	0	0	0	0	0		0	79.8	19.9	0	0.3		15.5	0	78.4	0.9	5.2		23.2	76.8	0	0	0		
Total %	0	0	0	0	0	0	0	23.8	5.9	0	0.1	29.8	3	0	15.2	0.2	1	19.4	11.8	39	0	0	0	50.7	
Vehicles	0	0	0	0	0	0	0	259	64	0	1	324	32	0	161	2	11	206	126	419	0	0	0	545	1075
% Vehicles	0	0	0	0	0	0	0	99.2	98.5	0	100	99.1	97	0	96.4	100	100	96.7	97.7	98.1	0	0	0	98	98.1
Axles 2 & 3	0	0	0	0	0	0	0	2	1	0	0	3	1	0	6	0	0	7	3	8	0	0	0	11	21
% Axles 2 & 3	0	0	0	0	0	0	0	0.8	1.5	0	0	0.9	3	0	3.6	0	0	3.3	2.3	1.9	0	0	0	2	1.9
Axles 4 & Up	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Axles 4 & Up	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



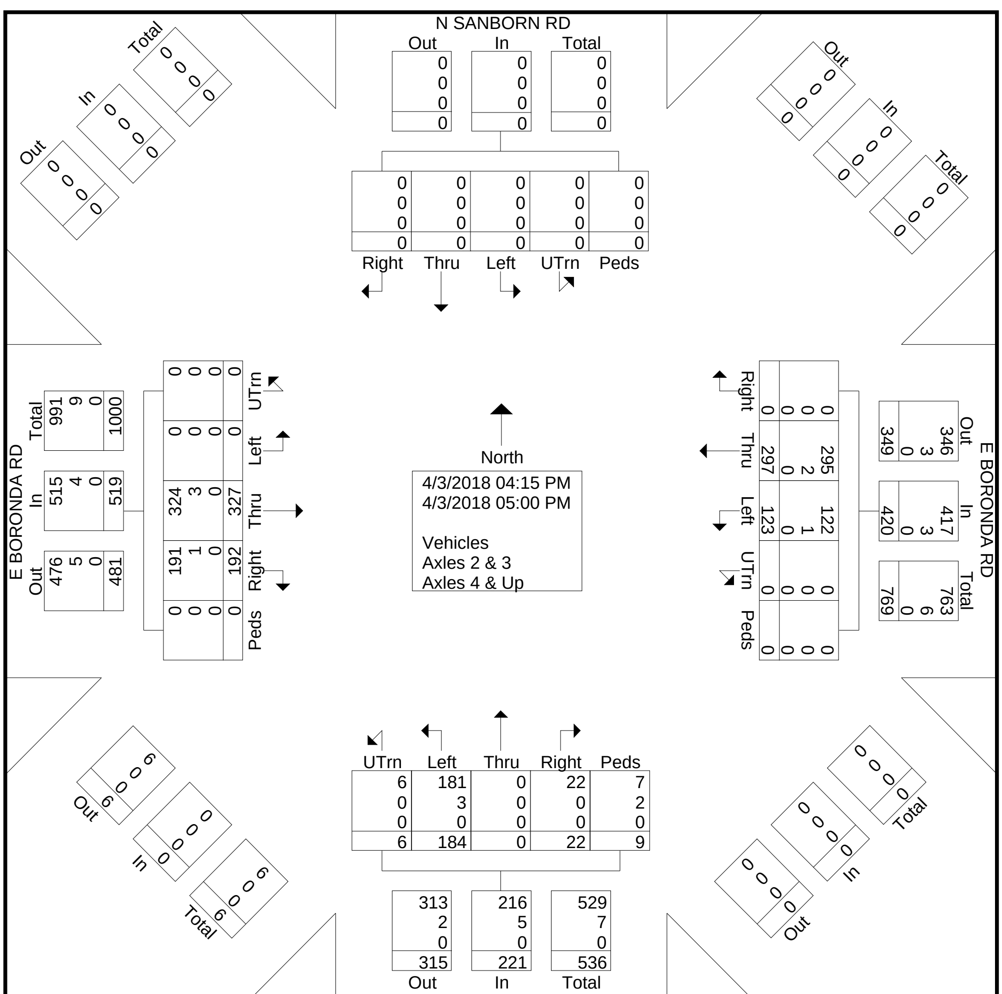
CITY OF SALINAS
TURNING MOVEMENT PROGRAM

E Boronda Rd. @ N Sanborn Rd.
Counted by: Miovision
Weather: Sunny
Hours: 4:15 pm to 5:15 pm

File Name : Boronda & Sanborn
Site Code :
Start Date : 4/3/2018
Page No : 1

Groups Printed- Vehicles - Axles 2 & 3 - Axles 4 & Up

	N SANBORN RD From North						E BORONDA RD From East						N SANBORN RD From South						E BORONDA RD From West						
Start Time	Right	Thru	Left	UTrn	Peds	App. Total	Right	Thru	Left	UTrn	Peds	App. Total	Right	Thru	Left	UTrn	Peds	App. Total	Right	Thru	Left	UTrn	Peds	App. Total	Int. Total
04:15 PM	0	0	0	0	0	0	0	74	28	0	0	102	7	0	51	1	2	61	56	75	0	0	0	131	294
04:30 PM	0	0	0	0	0	0	0	76	30	0	0	106	3	0	43	2	2	50	40	84	0	0	0	124	280
04:45 PM	0	0	0	0	0	0	0	72	26	0	0	98	3	0	53	2	3	61	47	81	0	0	0	128	287
Total	0	0	0	0	0	0	0	222	84	0	0	306	13	0	147	5	7	172	143	240	0	0	0	383	861
05:00 PM	0	0	0	0	0	0	0	75	39	0	0	114	9	0	37	1	2	49	49	87	0	0	0	136	299
Grand Total	0	0	0	0	0	0	0	297	123	0	0	420	22	0	184	6	9	221	192	327	0	0	0	519	1160
Apprch %	0	0	0	0	0		0	70.7	29.3	0	0		10	0	83.3	2.7	4.1		37	63	0	0	0		
Total %	0	0	0	0	0	0	0	25.6	10.6	0	0	36.2	1.9	0	15.9	0.5	0.8	19.1	16.6	28.2	0	0	0	44.7	
Vehicles	0	0	0	0	0	0	0	295	122	0	0	417	22	0	181	6	7	216	191	324	0	0	0	515	1148
% Vehicles	0	0	0	0	0	0	0	99.3	99.2	0	0	99.3	100	0	98.4	100	77.8	97.7	99.5	99.1	0	0	0	99.2	99
Axles 2 & 3	0	0	0	0	0	0	0	2	1	0	0	3	0	0	3	0	2	5	1	3	0	0	0	4	12
% Axles 2 & 3	0	0	0	0	0	0	0	0.7	0.8	0	0	0.7	0	0	1.6	0	22.2	2.3	0.5	0.9	0	0	0	0.8	1
Axles 4 & Up	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Axles 4 & Up	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Appendix E

LOS Analysis – Synchro and SIDRA

Intersection	
Int Delay, s/veh	7.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	167	33	65	261	427	129
Future Vol, veh/h	167	33	65	261	427	129
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	275	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	182	36	71	284	464	140

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	960	534	604	0	-	0
Stage 1	534	-	-	-	-	-
Stage 2	426	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	285	546	974	-	-	-
Stage 1	588	-	-	-	-	-
Stage 2	659	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	264	546	974	-	-	-
Mov Cap-2 Maneuver	264	-	-	-	-	-
Stage 1	545	-	-	-	-	-
Stage 2	659	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	38.8	1.8	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	974	-	264	546	-	-
HCM Lane V/C Ratio	0.073	-	0.688	0.066	-	-
HCM Control Delay (s)	9	-	44.1	12.1	-	-
HCM Lane LOS	A	-	E	B	-	-
HCM 95th %tile Q(veh)	0.2	-	4.6	0.2	-	-

Intersection	
Int Delay, s/veh	15.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	184	22	123	297	327	192
Future Vol, veh/h	184	22	123	297	327	192
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	275	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	200	24	134	323	355	209

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1051	460	564	0	-	0
Stage 1	460	-	-	-	-	-
Stage 2	591	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	251	601	1008	-	-	-
Stage 1	636	-	-	-	-	-
Stage 2	553	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	218	601	1008	-	-	-
Mov Cap-2 Maneuver	218	-	-	-	-	-
Stage 1	551	-	-	-	-	-
Stage 2	553	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	79.4	2.7	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1008	-	218	601	-	-
HCM Lane V/C Ratio	0.133	-	0.917	0.04	-	-
HCM Control Delay (s)	9.1	-	87.6	11.2	-	-
HCM Lane LOS	A	-	F	B	-	-
HCM 95th %tile Q(veh)	0.5	-	7.6	0.1	-	-

Intersection	
Int Delay, s/veh	48.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	265	33	65	297	477	278
Future Vol, veh/h	265	33	65	297	477	278
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	275	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	288	36	71	323	518	302

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1134	669	820	0	-	0
Stage 1	669	-	-	-	-	-
Stage 2	465	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 224	458	809	-	-	-
Stage 1	509	-	-	-	-	-
Stage 2	632	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 204	458	809	-	-	-
Mov Cap-2 Maneuver	~ 204	-	-	-	-	-
Stage 1	464	-	-	-	-	-
Stage 2	632	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	229.2	1.8	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	809	-	204	458	-	-
HCM Lane V/C Ratio	0.087	-	1.412	0.078	-	-
HCM Control Delay (s)	9.9	-	256.1	13.5	-	-
HCM Lane LOS	A	-	F	B	-	-
HCM 95th %tile Q(veh)	0.3	-	16.9	0.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	104.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	304	22	123	341	373	329
Future Vol, veh/h	304	22	123	341	373	329
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	275	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	330	24	134	371	405	358

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1223	584	763	0	-	0
Stage 1	584	-	-	-	-	-
Stage 2	639	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 198	512	850	-	-	-
Stage 1	557	-	-	-	-	-
Stage 2	526	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 167	512	850	-	-	-
Mov Cap-2 Maneuver	~ 167	-	-	-	-	-
Stage 1	469	-	-	-	-	-
Stage 2	526	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 473.5	2.7	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	850	-	167	512	-	-
HCM Lane V/C Ratio	0.157	-	1.979	0.047	-	-
HCM Control Delay (s)	10	-	$ 506.9	12.4	-	-
HCM Lane LOS	B	-	F	B	-	-
HCM 95th %tile Q(veh)	0.6	-	25.3	0.1	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	167	33	65	261	427	129
Future Volume (veh/h)	167	33	65	261	427	129
Number	7	14	5	2	6	16
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1900
Adj Flow Rate, veh/h	182	36	71	284	464	140
Adj No. of Lanes	1	1	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	260	232	123	1144	585	176
Arrive On Green	0.15	0.15	0.07	0.61	0.43	0.43
Sat Flow, veh/h	1774	1583	1774	1863	1375	415
Grp Volume(v), veh/h	182	36	71	284	0	604
Grp Sat Flow(s),veh/h/ln	1774	1583	1774	1863	0	1790
Q Serve(g_s), s	3.7	0.7	1.5	2.6	0.0	11.0
Cycle Q Clear(g_c), s	3.7	0.7	1.5	2.6	0.0	11.0
Prop In Lane	1.00	1.00	1.00			0.23
Lane Grp Cap(c), veh/h	260	232	123	1144	0	761
V/C Ratio(X)	0.70	0.15	0.58	0.25	0.00	0.79
Avail Cap(c_a), veh/h	852	761	240	1626	0	1107
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	15.3	14.0	17.0	3.3	0.0	9.4
Incr Delay (d2), s/veh	3.4	0.3	4.2	0.1	0.0	2.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.0	0.7	0.9	1.4	0.0	5.9
LnGrp Delay(d),s/veh	18.7	14.3	21.2	3.4	0.0	11.9
LnGrp LOS	B	B	C	A		B
Approach Vol, veh/h	218			355	604	
Approach Delay, s/veh	18.0			7.0	11.9	
Approach LOS	B			A	B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		27.7		10.0	7.1	20.5		
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5		
Max Green Setting (Gmax), s		32.9		18.1	5.1	23.3		
Max Q Clear Time (g_c+I1), s		4.6		5.7	3.5	13.0		
Green Ext Time (p_c), s		1.7		0.5	0.0	3.0		

Intersection Summary	
HCM 2010 Ctrl Delay	11.6
HCM 2010 LOS	B

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	184	22	123	297	327	192
Future Volume (veh/h)	184	22	123	297	327	192
Number	7	14	5	2	6	16
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1900
Adj Flow Rate, veh/h	200	24	134	323	355	209
Adj No. of Lanes	1	1	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	276	247	174	1144	442	260
Arrive On Green	0.16	0.16	0.10	0.61	0.40	0.40
Sat Flow, veh/h	1774	1583	1774	1863	1101	648
Grp Volume(v), veh/h	200	24	134	323	0	564
Grp Sat Flow(s),veh/h/ln	1774	1583	1774	1863	0	1748
Q Serve(g_s), s	4.2	0.5	2.9	3.2	0.0	11.2
Cycle Q Clear(g_c), s	4.2	0.5	2.9	3.2	0.0	11.2
Prop In Lane	1.00	1.00	1.00			0.37
Lane Grp Cap(c), veh/h	276	247	174	1144	0	701
V/C Ratio(X)	0.72	0.10	0.77	0.28	0.00	0.80
Avail Cap(c_a), veh/h	816	728	295	1571	0	983
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	15.7	14.2	17.2	3.5	0.0	10.4
Incr Delay (d2), s/veh	3.6	0.2	7.0	0.1	0.0	3.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.3	0.5	1.8	1.7	0.0	6.0
LnGrp Delay(d),s/veh	19.3	14.3	24.3	3.7	0.0	13.7
LnGrp LOS	B	B	C	A		B
Approach Vol, veh/h	224			457	564	
Approach Delay, s/veh	18.8			9.7	13.7	
Approach LOS	B			A	B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		28.5		10.6	8.3	20.2		
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5		
Max Green Setting (Gmax), s		33.0		18.0	6.5	22.0		
Max Q Clear Time (g_c+I1), s		5.2		6.2	4.9	13.2		
Green Ext Time (p_c), s		2.0		0.5	0.0	2.5		

Intersection Summary			
HCM 2010 Ctrl Delay			13.2
HCM 2010 LOS			B

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	265	33	65	297	477	278
Future Volume (veh/h)	265	33	65	297	477	278
Number	7	14	5	2	6	16
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1900
Adj Flow Rate, veh/h	288	36	71	323	518	302
Adj No. of Lanes	1	1	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	349	312	102	1222	580	338
Arrive On Green	0.20	0.20	0.06	0.66	0.53	0.53
Sat Flow, veh/h	1774	1583	1774	1863	1105	644
Grp Volume(v), veh/h	288	36	71	323	0	820
Grp Sat Flow(s),veh/h/ln	1774	1583	1774	1863	0	1749
Q Serve(g_s), s	9.5	1.1	2.4	4.4	0.0	25.6
Cycle Q Clear(g_c), s	9.5	1.1	2.4	4.4	0.0	25.6
Prop In Lane	1.00	1.00	1.00			0.37
Lane Grp Cap(c), veh/h	349	312	102	1222	0	919
V/C Ratio(X)	0.82	0.12	0.70	0.26	0.00	0.89
Avail Cap(c_a), veh/h	531	473	148	1452	0	1089
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	23.6	20.2	28.3	4.4	0.0	13.0
Incr Delay (d2), s/veh	6.4	0.2	8.4	0.1	0.0	8.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.3	1.1	1.4	2.3	0.0	14.2
LnGrp Delay(d),s/veh	29.9	20.4	36.7	4.5	0.0	21.5
LnGrp LOS	C	C	D	A		C
Approach Vol, veh/h	324			394	820	
Approach Delay, s/veh	28.9			10.3	21.5	
Approach LOS	C			B	C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		44.6		16.5	8.0	36.6		
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5		
Max Green Setting (Gmax), s		47.7		18.3	5.1	38.1		
Max Q Clear Time (g_c+I1), s		6.4		11.5	4.4	27.6		
Green Ext Time (p_c), s		2.1		0.6	0.0	4.5		

Intersection Summary		
HCM 2010 Ctrl Delay		20.2
HCM 2010 LOS		C

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	304	22	123	341	373	329
Future Volume (veh/h)	304	22	123	341	373	329
Number	7	14	5	2	6	16
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1900
Adj Flow Rate, veh/h	330	24	134	371	405	358
Adj No. of Lanes	1	1	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	382	341	170	1217	449	397
Arrive On Green	0.22	0.22	0.10	0.65	0.49	0.49
Sat Flow, veh/h	1774	1583	1774	1863	913	807
Grp Volume(v), veh/h	330	24	134	371	0	763
Grp Sat Flow(s),veh/h/ln	1774	1583	1774	1863	0	1720
Q Serve(g_s), s	12.3	0.8	5.1	5.9	0.0	27.7
Cycle Q Clear(g_c), s	12.3	0.8	5.1	5.9	0.0	27.7
Prop In Lane	1.00	1.00	1.00			0.47
Lane Grp Cap(c), veh/h	382	341	170	1217	0	847
V/C Ratio(X)	0.86	0.07	0.79	0.30	0.00	0.90
Avail Cap(c_a), veh/h	479	428	220	1429	0	993
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	25.9	21.4	30.3	5.1	0.0	15.9
Incr Delay (d2), s/veh	12.8	0.1	13.5	0.1	0.0	10.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.3	0.8	3.1	3.0	0.0	15.3
LnGrp Delay(d),s/veh	38.7	21.5	43.8	5.3	0.0	26.0
LnGrp LOS	D	C	D	A		C
Approach Vol, veh/h	354			505	763	
Approach Delay, s/veh	37.5			15.5	26.0	
Approach LOS	D			B	C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		49.2		19.2	11.0	38.2		
Change Period (Y+Rc), s		4.5		4.5	4.5	4.5		
Max Green Setting (Gmax), s		52.5		18.5	8.5	39.5		
Max Q Clear Time (g_c+I1), s		7.9		14.3	7.1	29.7		
Green Ext Time (p_c), s		2.5		0.5	0.0	4.0		

Intersection Summary	
HCM 2010 Ctrl Delay	25.2
HCM 2010 LOS	C

LANE SUMMARY

Site: 101 [INT-01_Alt00_2018AM_Boronda/Sanborn]

E Boronda Rd at N Sanborn Rd
Roundabout

Lane Use and Performance														
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Boronda Rd													
Lane 1[d]	354	2.0	1180	0.300	100	5.9	LOS A	1.6	39.7	Full	1100	0.0	0.0
Approach	354	2.0		0.300		5.9	LOS A	1.6	39.7				
North: SB Boronda Rd													
Lane 1[d]	604	2.0	1311	0.461	100	7.4	LOS A	3.3	83.9	Full	920	0.0	0.0
Approach	604	2.0		0.461		7.4	LOS A	3.3	83.9				
West: EB Sanborn Rd													
Lane 1[d]	220	2.0	880	0.250	100	6.7	LOS A	1.2	29.2	Full	1850	0.0	0.0
Approach	220	2.0		0.250		6.7	LOS A	1.2	29.2				
Intersection	1178	2.0		0.461		6.8	LOS A	3.3	83.9				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
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 6).
Roundabout Capacity Model: US HCM 2010.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [INT-01_Alt00_2018PM_Boronda/Sanborn]

E Boronda Rd at N Sanborn Rd
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Boronda Rd													
Lane 1[d]	457	2.0	1156	0.395	100	7.1	LOS A	2.3	57.2	Full	1100	0.0	0.0
Approach	457	2.0		0.395		7.1	LOS A	2.3	57.2				
North: SB Boronda Rd													
Lane 1[d]	564	2.0	1224	0.461	100	7.7	LOS A	3.1	79.1	Full	920	0.0	0.0
Approach	564	2.0		0.461		7.7	LOS A	3.1	79.1				
West: EB Sanborn Rd													
Lane 1[d]	230	1.9	983	0.234	100	6.0	LOS A	1.1	28.2	Full	1850	0.0	0.0
Approach	230	1.9		0.234		6.0	LOS A	1.1	28.2				
Intersection	1251	2.0		0.461		7.2	LOS A	3.1	79.1				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
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 6).
Roundabout Capacity Model: US HCM 2010.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [INT-01_Alt00_2028AM_Boronda/Sanborn]

E Boronda Rd at N Sanborn Rd
Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Boronda Rd													
Lane 1[d]	393	2.0	1061	0.371	100	7.2	LOS A	2.0	50.5	Full	1100	0.0	0.0
Approach	393	2.0		0.371		7.2	LOS A	2.0	50.5				
North: SB Boronda Rd													
Lane 1[d]	821	2.0	1311	0.626	100	10.4	LOS B	6.1	153.7	Full	920	0.0	0.0
Approach	821	2.0		0.626		10.4	LOS B	6.1	153.7				
West: EB Sanborn Rd													
Lane 1[d]	326	2.0	832	0.392	100	9.0	LOS A	2.0	51.4	Full	1850	0.0	0.0
Approach	326	2.0		0.392		9.0	LOS A	2.0	51.4				
Intersection	1540	2.0		0.626		9.3	LOS A	6.1	153.7				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
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 6).
Roundabout Capacity Model: US HCM 2010.
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.

d Dominant lane on roundabout approach

Organisation: KIMLEY-HORN & ASSOCIATES INC | Processed: Tuesday, June 5, 2018 1:03:53 PM
Project: K:\SAC_TPTO\City of Salinas, On-Call - ICE\03 Analysis Files\Sidra Files\INT-01_E Boronda at N Sanborn.sip7

LANE SUMMARY

Site: 101 [INT-01_Alt00_2028PM_Boronda/Sanborn]

E Boronda Rd at N Sanborn Rd
Roundabout

Lane Use and Performance														
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Boronda Rd													
Lane 1[d]	504	2.0	1015	0.497	100	9.5	LOS A	3.1	78.2	Full	1100	0.0	0.0
Approach	504	2.0		0.497		9.5	LOS A	3.1	78.2				
North: SB Boronda Rd													
Lane 1[d]	763	2.0	1224	0.623	100	10.8	LOS B	5.5	138.5	Full	920	0.0	0.0
Approach	763	2.0		0.623		10.8	LOS B	5.5	138.5				
West: EB Sanborn Rd													
Lane 1[d]	361	2.0	934	0.386	100	8.2	LOS A	2.0	51.7	Full	1850	0.0	0.0
Approach	361	2.0		0.386		8.2	LOS A	2.0	51.7				
Intersection	1628	2.0		0.623		9.8	LOS A	5.5	138.5				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
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 6).
Roundabout Capacity Model: US HCM 2010.
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.

d Dominant lane on roundabout approach

Appendix F

Preliminary Opinion of Probable Costs

The Consultant has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Consultant at this time and represent only the Consultant's judgment as a design professional familiar with the construction industry. The Consultant cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

E Boronda Road at N Sanborn Road Intersection

Description: Alternative A: Traffic Signal

Total Project Cost (2018 Dollars)	$ 1,028,900

Total Construction Costs:	$	685,900
Total Right of Way Costs:	$	-
Total Capital Support Costs:	$	343,000

Construction Costs

Roadway Items

Section	Description	Quantity	Unit	Unit Price	Cost
1a	Roadway Excavation	0	CY	$ 90.00	$ -
1b	Concrete Removal	0	CY	$ 150.00	$ -
1c	Clearing & Grabbing	0	SF	$ 1.00	$ -
1d	Import Borrow	0	CY	$ 100.00	$ -
1e	HMA Pavement	375	TON	$ 165.00	$ 61,900
1f	Aggregate Base	0	CY	$ 80.00	$ -
1g	Truck Apron	0	SF	$ 25.00	$ -
1h	Curb	0	LF	$ 40.00	$ -
1i	Curb and Gutter	0	LF	$ 60.00	$ -
1j	Sidewalk	0	SF	$ 20.00	$ -
1k	Curb Ramp	0	EA	$ 5,000.00	$ -
1l	Storm Drain System	1	LS	$ 4,000.00	$ 4,000
1m	Storm Water Runoff Treatment	0	SF	$ 100.00	$ -
				Subtotal Section 1:	$ 65,900
2a	Water Pollution Control	2%	of Sections 1		$ 2,000
2b	Lighting	0	EA	$ 10,000.00	$ -
2c	Utility Adjustments / Relocations	0	LS	$ 80,000.00	$ -
2d	Traffic Items	15%	of Sections 1		$ 10,000
2e	Traffic Signals	1	EA	$ 350,000.00	$ 350,000
2f	Traffic Control	1	LS	$ 10,000.00	$ 10,000
2g	Planting and Irrigation	0	SF	$ 10.00	$ -
2h	Erosion Control	10%	of Sections 1		$ 7,000
				Subtotal Section 2:	$ 379,000
3a	Minor Items	10%	Sect 1-2	$ 444,900	$ 45,000
3b	Roadway Mobilization	10%	Sect 1-2-3a	$ 489,900	$ 49,000
3c	Supplemental Work	10%	Sect 1-2-3a	$ 489,900	$ 49,000
3d	Contingencies	20%	Sect 1-2-3a	$ 489,900	$ 98,000
				Subtotal Sections 3:	$ 241,000
				Total Roadway Item Cost:	**$ 685,900**

LM = Lane Mile Equivalent

Structure Items

Structure	Description	Quantity	Unit	Unit Price	Cost
1		0	EA	$ -	$ -
2		0	EA	$ -	$ -
3		0	EA	$ -	$ -
4		0	SF	$ -	$ -
5		0	SF	$ -	$ -
6		0	SF	$ -	$ -
7		0	SF	$ -	$ -
8		0	SF	$ -	$ -
9		0	SF	$ -	$ -
10		0	SF	$ -	$ -
11		0	SF	$ -	$ -
12		0	SF	$ -	$ -
13		0	SF	$ -	$ -
		Subtotal Structure Items:			$ -
	Contingency for Structure Items:	40%		Contingency Cost	$ -
				Total Structure Item Cost:	**$ -**

Construction Cost Summary

Roadway Items	$	685,900
Structure Items	$	-
Total Construction Costs:	**$**	**685,900**

Capital Support Costs

Description	%	Cost
Project Initiation Document (PID)	10%	$ 68,590
Project Engineering (PA/ED and PS&E)	20%	$ 137,180
Construction Support / Construction Management	20%	$ 137,180
Right of Way Support	5%	$ -
Total Professional Services Cost:		**$ 343,000**

Right of Way

Parcel Type	Quantity	Unit	Unit Price	Cost
Commercial	0	AC	$ 875,000.00	$ -
Residential	0	AC	$ 435,600.00	$ -
Undeveloped	0	AC	$ 653,400.00	$ -
			Subtotal Right of Way Items:	$ -
Contingency for Right of Way Items:	25%		Contingency Cost	$ -
			Total Right of Way Cost:	**$ -**

E Boronda Road at N Sanborn Road Intersection

Description: Alternative B: Roundabout

Total Project Cost (2018 Dollars) **$ 2,387,700**

Total Construction Costs:	$	1,591,700
Total Right of Way Costs:	$	-
Total Capital Support Costs:	$	796,000

Construction Costs

Roadway Items

Section	Description	Quantity	Unit	Unit Price	Cost
1a	Roadway Excavation	1475	CY	$ 90.00	$ 132,800
1b	Concrete Removal	15	CY	$ 150.00	$ 2,300
1c	Clearing & Grabbing	0	SF	$ 1.00	$ -
1d	Import Borrow	0	CY	$ 100.00	$ -
1e	HMA Pavement	550	TON	$ 165.00	$ 90,800
1f	Aggregate Base	502	CY	$ 80.00	$ 40,200
1g	Truck Apron	2180	SF	$ 25.00	$ 54,500
1h	Curb	1492	LF	$ 40.00	$ 59,700
1i	Curb and Gutter	980	LF	$ 60.00	$ 58,800
1j	Sidewalk	2535	SF	$ 20.00	$ 50,700
1k	Curb Ramp	14	EA	$ 5,000.00	$ 70,000
1l	Storm Drain System	1	LS	$ 28,000.00	$ 28,000
1m	Storm Water Runoff Treatment	613	SF	$ 100.00	$ 61,300
				Subtotal Section 1:	$ 649,100
2a	Water Pollution Control	2%	of Sections 1		$ 13,000
2b	Lighting	6	EA	$ 10,000.00	$ 60,000
2c	Utility Adjustments / Relocations	0	LS	$ 80,000.00	$ -
2d	Traffic Items	15%	of Sections 1		$ 98,000
2e	Traffic Signals	0	EA	$ 350,000.00	$ -
2f	Traffic Control	1	LS	$ 10,000.00	$ 10,000
2g	Planting and Irrigation	13660	SF	$ 10.00	$ 136,600
2h	Erosion Control	10%	of Sections 1		$ 65,000
				Subtotal Section 2:	$ 382,600
3a	Minor Items	10%	Sect 1-2	$ 1,031,700	$ 104,000
3b	Roadway Mobilization	10%	Sect 1-2-3a	$ 1,135,700	$ 114,000
3c	Supplemental Work	10%	Sect 1-2-3a	$ 1,135,700	$ 114,000
3d	Contingencies	20%	Sect 1-2-3a	$ 1,135,700	$ 228,000
				Subtotal Sections 3:	$ 560,000
				Total Roadway Item Cost:	**$ 1,591,700**

LM = Lane Mile Equivalent

Structure Items

Structure	Description	Quantity	Unit	Unit Price	Cost
1		0	EA	$ -	$ -
2		0	EA	$ -	$ -
3		0	EA	$ -	$ -
4		0	SF	$ -	$ -
5		0	SF	$ -	$ -
6		0	SF	$ -	$ -
7		0	SF	$ -	$ -
8		0	SF	$ -	$ -
9		0	SF	$ -	$ -
10		0	SF	$ -	$ -
11		0	SF	$ -	$ -
12		0	SF	$ -	$ -
13		0	SF	$ -	$ -
				Subtotal Structure Items:	$ -
	Contingency for Structure Items:	40%		Contingency Cost	$ -
				Total Structure Item Cost:	**$ -**

Construction Cost Summary

Roadway Items	$	1,591,700
Structure Items	$	-
Total Construction Costs:	**$**	**1,591,700**

Capital Support Costs

Description	%	Cost
Project Initiation Document (PID)	10%	$ 159,170
Project Engineering (PA/ED and PS&E)	20%	$ 318,340
Construction Support / Construction Management	20%	$ 318,340
Right of Way Support	5%	$ -
Total Professional Services Cost:		**$ 796,000**

Right of Way

Parcel Type	Quantity	Unit	Unit Price	Cost
Commercial	0	AC	$ 875,000.00	$ -
Residential	0	AC	$ 435,600.00	$ -
Undeveloped	0	AC	$ 653,400.00	$ -
			Subtotal Right of Way Items:	$ -
Contingency for Right of Way Items:	25%		Contingency Cost	$ -
			Total Right of Way Cost:	**$ -**

E Boronda Road at N Sanborn Road Intersection

Description: Alternative C: Mini-Roundabout

Total Project Cost (2018 Dollars)	$ 935,850

Total Construction Costs:	$	623,850
Total Right of Way Costs:	$	-
Total Capital Support Costs:	$	312,000

Construction Costs

Roadway Items

Section	Description	Quantity	Unit	Unit Price	Cost
1a	Roadway Excavation	505	CY	$ 90.00	$ 45,500
1b	Concrete Removal	0.2	CY	$ 150.00	$ 100
1c	Clearing & Grabbing	0	SF	$ 1.00	$ -
1d	Import Borrow	0	CY	$ 100.00	$ -
1e	HMA Pavement	287	TON	$ 165.00	$ 47,400
1f	Aggregate Base	63	CY	$ 80.00	$ 5,100
1g	Truck Apron	542	SF	$ 25.00	$ 13,600
1h	Curb	495	LF	$ 40.00	$ 19,800
1i	Curb and Gutter	905	LF	$ 60.00	$ 54,300
1j	Sidewalk	1095	SF	$ 20.00	$ 21,900
1k	Curb Ramp	5	EA	$ 5,000.00	$ 25,000
1l	Storm Drain System	1	LS	$ 12,000.00	$ 12,000
1m	Storm Water Runoff Treatment	198	SF	$ 100.00	$ 19,800
				Subtotal Section 1:	$ 264,500
2a	Water Pollution Control	2%	of Sections 1		$ 6,000
2b	Lighting	4	EA	$ 10,000.00	$ 40,000
2c	Utility Adjustments / Relocations	0	LS	$ 80,000.00	$ -
2d	Traffic Items	15%	of Sections 1		$ 40,000
2e	Traffic Signals	0	EA	$ 350,000.00	$ -
2f	Traffic Control	1	LS	$ 10,000.00	$ 10,000
2g	Planting and Irrigation	1635	SF	$ 10.00	$ 16,350
2h	Erosion Control	10%	of Sections 1		$ 27,000
				Subtotal Section 2:	$ 139,350
3a	Minor Items	10%	Sect 1-2	$ 403,850	$ 41,000
3b	Roadway Mobilization	10%	Sect 1-2-3a	$ 444,850	$ 45,000
3c	Supplemental Work	10%	Sect 1-2-3a	$ 444,850	$ 45,000
3d	Contingencies	20%	Sect 1-2-3a	$ 444,850	$ 89,000
				Subtotal Sections 3:	$ 220,000
				Total Roadway Item Cost:	**$ 623,850**

LM = Lane Mile Equivalent

Structure Items

Structure	Description	Quantity	Unit	Unit Price	Cost
1		0	EA	$ -	$ -
2		0	EA	$ -	$ -
3		0	EA	$ -	$ -
4		0	SF	$ -	$ -
5		0	SF	$ -	$ -
6		0	SF	$ -	$ -
7		0	SF	$ -	$ -
8		0	SF	$ -	$ -
9		0	SF	$ -	$ -
10		0	SF	$ -	$ -
11		0	SF	$ -	$ -
12		0	SF	$ -	$ -
13		0	SF	$ -	$ -
		Subtotal Structure Items:			$ -
	Contingency for Structure Items:	40%		Contingency Cost	$ -
				Total Structure Item Cost:	**$ -**

Construction Cost Summary

Roadway Items	$	623,850
Structure Items	$	-
Total Construction Costs:	**$**	**623,850**

Capital Support Costs

Description	%	Cost
Project Initiation Document (PID)	10%	$ 62,385
Project Engineering (PA/ED and PS&E)	20%	$ 124,770
Construction Support / Construction Management	20%	$ 124,770
Right of Way Support	5%	$ -
Total Professional Services Cost:		**$ 312,000**

Right of Way

Parcel Type	Quantity	Unit	Unit Price	Cost
Commercial	0	AC	$ 875,000.00	$ -
Residential	0	AC	$ 435,600.00	$ -
Undeveloped	0	AC	$ 653,400.00	$ -
			Subtotal Right of Way Items:	$ -
Contingency for Right of Way Items:	25%		Contingency Cost	$ -
			Total Right of Way Cost:	**$ -**

Appendix G

Safety Analysis

Kimley»Horn

Summary of Predicted Crashes by Alternative
East Boronda Road at North Sanborn Road
Date: 06/19/2018
Prepared by: Marisa Bachelor

Alternative	Expected Crashes (2018 - 2028)						Notes
	Total	K	A	B	C	O	
Existing Geometry	13.43	0.3%	6.4%	15.4%	50.6%	27.4%	IHSDM has a SPF broken down by severity level.
		0.04	0.86	2.06	6.79	3.68	
Signalized	16.55	0.3%	2.9%	13.6%	31.3%	51.9%	
		0.05	0.48	2.25	5.18	8.58	
Roundabout	7.52	0.3%	6.4%	15.4%	50.6%	27.4%	
		0.02	0.48	1.15	3.80	2.06	
Mini-Roundabout	7.52	0.3%	6.4%	15.4%	50.6%	27.4%	Research is not available on mini-roundabout safety for the United States. Assumed that the mini-roundabout has the same crash distribution as the roundabout.
		0.02	0.48	1.15	3.80	2.06	

Appendix H

Life-Cycle Benefit-Cost Analysis and Sensitivity Analysis

MISCELLANEOUS LIFE CYCLE CALCULATIONS

LIFE CYCLE VARIABLES			
Discount Rate:	4.00%	Exist Year:	2018
P/F Factor (Pavement Rehabilitation):	0.456386946	Design Year:	2028
P/A Factor:	8.110895779	No. Years:	10

PAVEMENT REHABILITATION O&M COST

Estimated years after opening resurfacing occurs: 20

Cost per SY: $ 20.00

	Existing	Signal	Roundabout	Mini-Roundabout
Pavement Rehabilitation SY	3337	3337	2452	2382
Cost	$ 66,740	$ 66,740	$ 49,040	$ 47,640
Discounted Cost	$ 30,459	$ 30,459	$ 22,381.22	$ 21,742.27

LIFE CYCLE COST CALCULATIONS

PERFORMANCE MEASURE LIFE CYCLE COST (NET PRESENT VALUE)

	Safety			
	Intersection Control Types			
	Existing	Signal	Roundabout	Mini-Roundabout
Annual Cost of Collisions	$ 135,572	$ 123,701	$ 75,902	$ 75,902
Discounted Life Cycle Cost of Collisions	$ 1,099,608	$ 1,003,330	$ 615,637	$ 615,637

	Delay			
	Existing	Signal	Roundabout	Mini-Roundabout
Annual Quantity (hours)	52,776	3,909	1,807	1,807
Annual Cost	778,728	59,393	27,743	27,743
Total Discounted Life Cycle Cost	$ 8,566,009	$ 653,328	$ 305,169	$ 305,169

	O&M			
	Existing	Signal	Roundabout	Mini-Roundabout
Annual O&M Costs	$ 560	$ 6,660	$ 2,240	$ 1,000
Discounted Life Cycle O&M Costs	$ 4,542	$ 54,019	$ 18,168.41	$ 8,111
Discounted Pavement Rehab Costs	$ 30,459	$ 30,459	$ 22,381	$ 21,742
Total O&M Costs	$ 35,001	$ 84,478	$ 40,550	$ 29,853

	Initial Capital			
	Existing	Signal	Roundabout	Mini-Roundabout
Initial Capital Costs	$ -	$ 1,028,900	$ 2,387,700	$ 935,850

TOTAL PROJECT LIFE CYCLE SUMMARY FOR 10 YEARS

	Existing	Signal	Roundabout	Mini-Roundabout
Safety	$ 1,099,608	$ 1,003,330	$ 615,637	$ 615,637
Delay	$ 8,566,009	$ 653,328	$ 305,169	$ 305,169
O&M	$ 35,001	$ 84,478	$ 40,550	$ 29,853
Initial Capital	$ -	$ 1,028,900	$ 2,387,700	$ 935,850
Total Net Present Value	**$ 9,700,618**	**$ 2,770,035**	**$ 3,349,056**	**$ 1,886,509**

LIFE CYCLE BENEFIT COST RATIO

	Total Benefits (B)			
Added Benefits Compared to Existing	Existing	Signal	Roundabout	Mini-Roundabout
Safety	$ -	$ 96,279	$ 483,971	$ 483,971
Delay	$ -	$ 7,912,681	$ 8,260,840	$ 8,260,840
Emission	$ -	$ (5,134)	$ -	$ -
Total Benefits	**$ -**	**$ 8,003,825**	**$ 8,744,811**	**$ 8,744,811**

	Total Costs (C)			
Added Cost Compared to Existing	Existing	Signal	Roundabout	Mini-Roundabout
O&M	$ -	$ 49,476	$ 5,548	$ (5,148)
Initial Capital	$ -	$ 1,028,900	$ 2,387,700	$ 935,850
Total Costs	**$ -**	**$ 1,078,376**	**$ 2,393,248**	**$ 930,702**

B/C Ratio Compared to Existing		**7.42**	**3.65**	**9.40**

IN PROGRESS

Capital Cost Worksheet

E Boronda Rd at N Sanborn Rd: Traffic Signal vs. Mini-Roundabout Alternative

	Capital Cost			Project Constants			
B/C Target	Traffic Signal (a)	Mini-Roundabout (b)	Added Cost for Mini-Roundabout (c) = (b - a)	Added O&M Cost for Mini-Roundabout (d)	Total Benefits (e)	Total Costs (f) = (c + d)	B/C (g) = (e / f)
Actual	$ 1,028,900	$ 935,850	$ (93,050)	$ (54,625)	$ 740,986	$ (147,675)	NA-R
High	$ 1,131,790	$ 842,265	$ (289,525)			$ (344,150)	NA-R
Low	$ 926,010	$ 1,029,435	$ 103,425			$ 48,800	15.18
Breakeven	$ 1,028,900	$ 1,824,511	$ 795,611			$ 740,986	1.00
Custom 1							
Custom 2							

NA-R: Cost of Mini-Roundabout is less than cost of compared alternative

Capital Cost Relationship

(B/C=1.00)

Traffic Signal	Mini-Roundabout
$ -	$ -
$ -	$ 400,000
$ 4,389	$ 800,000
$ 404,389	$ 1,200,000
$ 804,389	$ 1,600,000
$ 1,204,389	$ 2,000,000
$ 1,604,389	$ 2,400,000
$ 2,004,389	$ 2,800,000
$ 2,404,389	$ 3,200,000
$ 2,804,389	$ 3,600,000

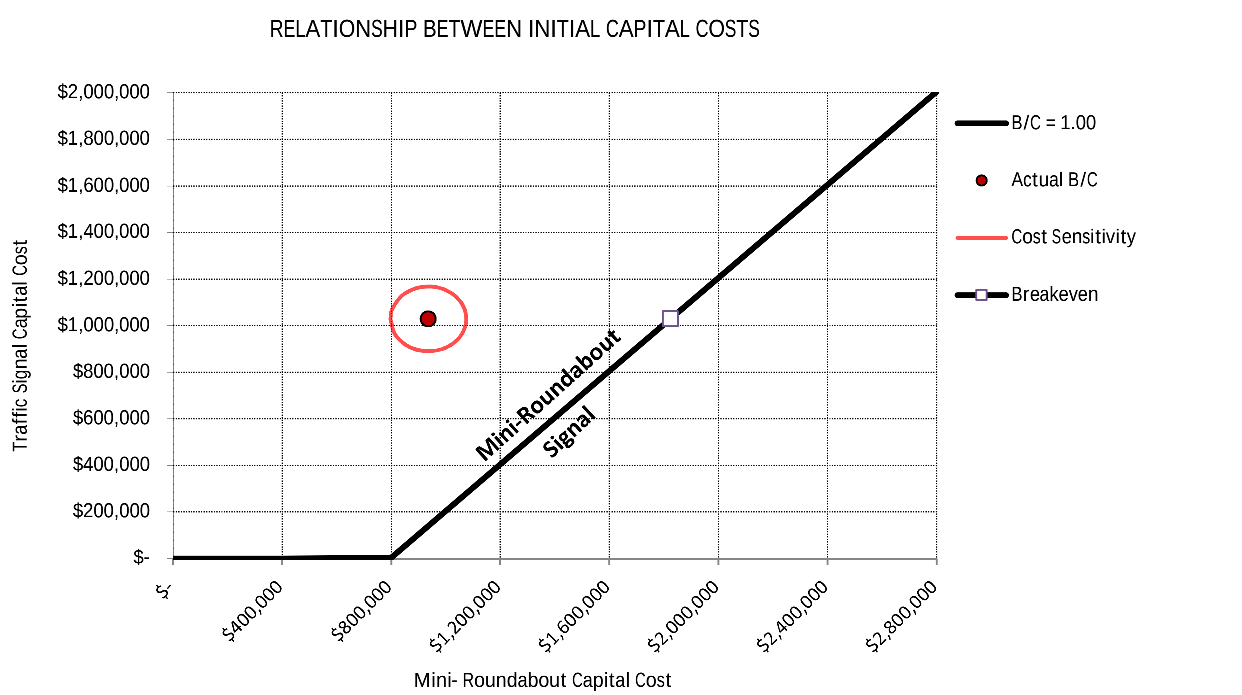
Cost Sensitivity Assumptions

	Percent Adjustment to Cost	
B/C Target	Traffic Signal	Mini-RAB
High	10%	-10%
Low	-10%	10%
Breakeven	0%	95%
Custom 1		
Custom 2		

Chart Assumptions

Cost Increase	$ 400,000	(x axis major unit)
Min Signal Cost	$ -	(Min. cost to construct a Signal

NOTE: Breakeven is the capital cost budget for a roundabout based on the actual capital cost of the signal alternative and a B/C = 1.00



IN PROGRESS

Capital Cost Worksheet

E Boronda Rd at N Sanborn Rd: Traffic Signal vs. Roundabout Alternative

B/C Target	Capital Cost: Traffic Signal (a)	Capital Cost: Roundabout (b)	Added Cost for Roundabout (c) = (b - a)	Project Constants: Added O&M Cost for Roundabout (d)	Project Constants: Total Benefits (e)	Total Costs (f) = (c + d)	B/C (g) = (e / f)
Actual	$ 1,028,900	$ 2,387,700	$ 1,358,800	$ (43,928)	$ 740,986	$ 1,314,872	0.56
High	$ 1,131,790	$ 2,148,930	$ 1,017,140			$ 973,212	0.76
Low	$ 926,010	$ 2,626,470	$ 1,700,460			$ 1,656,532	0.45
Breakeven	$ 1,028,900	$ 1,813,814	$ 784,914			$ 740,986	1.00
Custom 1							
Custom 2							

NA-R: Cost of Roundabout is less than cost of compared alternative

Capital Cost Relationship
(B/C=1.00)

Traffic Signal	Roundabout
$ -	$ -
$ -	$ 400,000
$ 15,086	$ 800,000
$ 415,086	$ 1,200,000
$ 815,086	$ 1,600,000
$ 1,215,086	$ 2,000,000
$ 1,615,086	$ 2,400,000
$ 2,015,086	$ 2,800,000
$ 2,415,086	$ 3,200,000
$ 2,815,086	$ 3,600,000

Cost Sensitivity Assumptions

B/C Target	Percent Adjustment to Cost: Traffic Signal	Percent Adjustment to Cost: Roundabout
High	10%	-10%
Low	-10%	10%
Breakeven	0%	-24%
Custom 1		
Custom 2		

Chart Assumptions

Cost Increase	$ 400,000	(x axis major unit)
Min Signal Cost	$ -	(Min. cost to construct a Signal)

NOTE: Breakeven is the capital cost budget for a roundabout based on the actual capital cost of the signal alternative and a B/C = 1.00