# Appendix C: Existing Traffic Conditions Memo









Real People. Real Solutions.

12224 Nicollet Avenue Burnsville, MN 55337-1649

> Ph: (952) 890-0509 Fax: (952) 890-8065 Bolton-Menk.com

## **MEMORANDUM**

Date: April 30, 2019
To: Tim Gladhill, AICP Melissa Barnes, P.E.
From: Ross B. Tillman, P.E. Kelsey E. Retherford, E.I.T.
Subject: Ramsey Highway 10 Corridor Improvements Existing and 2025/2045 No Build Traffic Conditions City of Ramsey Project No.: T61.116411

## Introduction

This memorandum provides the existing traffic analysis for the Ramsey Highway 10 Corridor Improvements project.

## A. Function

Highway 10 throughout the City of Ramsey is classified as a Principal Arterial. It provides direct and relatively high speed service for vehicles. The existing Annual Average Daily Traffic (AADT) ranges from 35,500 vehicles on the west end and 55,000 vehicles on the east end of the City of Ramsey. To the east Highway 10 in Anoka is planned to be converted from an expressway to a freeway in 2022-2023 with the grade separation of Fairoak Avenue and Thurston Avenue at TH 10. To the west of the project in Elk River, TH 169 is also planned to be converted to a freeway.

## **B.** Access Inventory

## a. Primary Intersection Spacing

Highway 10 is defined as a Non-Interstate Freeway throughout the study area according to the Minnesota Department of Transportation (MnDOT) Access Management Manual. A Non-Interstate Freeway Corridor is identified as Category 1AF based on the functional classification of the roadway. A primary intersection refers to a junction between two roads in which all movements are maintained. The recommended minimum spacing between two at-grade, full movement intersection on a AF highway is one mile. The desirable spacing between an at grade intersection and the merge point of the closest ramp should be a minimum of one-half mile. **Table 1** shows what spacing recommendations are met throughout the corridor. Jarvis St to Alpine Dr are the only two primary intersections that do not meet the recommended spacing

Primary Intersections	Miles*	Meets Spacing Recommendation
Jarvis St to Alpine Dr	0.44	No
Alpine Dr to Armstrong Blvd	2.16	Yes
Armstrong Blvd to Ramsey Blvd	1.20	Yes
Ramsey Blvd to Sunfish Lake Blvd	1.09	Yes

## **Table 1. Distance Between Primary Intersections**

\*Recommended spacing is 1 mile in the MnDOT Access Management Manual

## b. Secondary Intersection Spacing

A secondary intersection refers to a junction between a major road and a minor road or a local street and are located between primary intersections. Interim spacing requirements for a Category 1AF roadway in transition does not specifically recommend secondary intersection spacing, so these intersections were evaluated using a spacing of  $\frac{1}{2}$  mile. **Tables 2** and **3** below show the secondary intersections and corresponding pass or fail grade based on existing spacing to the nearest primary intersection.

Secondary Intersections	Distance Between Secondary Intersections*	Category 1B
Jarvis St - Adams St (Full Access)	0.25	FAIL
Adams St (Full Access) - Alpine Dr	0.20	FAIL
Alpine Dr – 153 <sup>rd</sup> Ave (Full Access)	0.20	FAIL
153 <sup>rd</sup> Ave (Full Access) - Beatty St (Full Access)	0.55	PASS
Beatty St (Full Access) - Bowers Dr	0.30	FAIL
Bowers Dr - Field Access (Full Access)	0.10	FAIL
Field Access (Full Access) - Armstrong Blvd	1.10	PASS
Armstrong Blvd - Ramsey Blvd	1.15	PASS
Ramsey Blvd - Feldspar St (3/4 Access)	0.55	PASS
Feldspar St (3/4 Access) - Dolomite St (RIRO)	0.15	FAIL
Dolomite St (RIRO) - McKinley St Median Opening	0.10	FAIL
McKinley St Median Opening - Sunfish Lake Blvd	0.25	FAIL
Sunfish Lake Blvd - Tungsten St (RIRO)	0.25	FAIL
Tungsten St (RIRO) - Business Access (Full Access between Tungsten St & East City Limits)	0.14	FAIL

 Table 2. Distance between Secondary Intersections (Eastbound)

\*Recommended spacing is 0.5 mile in the MnDOT Access Management Manual

Secondary Intersections	Distance Between Secondary Intersections*	Category 1A
Business Access (Full Access between Tungsten St & East City Limits)- Sunfish Lake Blvd	0.40	FAIL
Sunfish Lake Blvd - Oak Terrace Median Opening	0.25	FAIL
McKinley St (Full Access) - Feldspar St (3/4 Access)	0.30	FAIL
Feldspar St (3/4 Access) - Ramsey Blvd	0.55	PASS
Ramsey Blvd - Armstrong Blvd	1.15	PASS
Armstrong Blvd - Field Access (Full Access)	1.10	PASS
Field Access (Full Access) - Bowers Dr	0.15	FAIL
Bowers Dr - Beatty St	0.25	FAIL
Beatty St - 153 <sup>rd</sup> Ave (Full Access)	0.55	PASS
153 <sup>rd</sup> Ave (Full Access) - Alpine Dr	0.20	FAIL
Alpine Dr - Adams St (RIRO)	0.20	FAIL
Adams St (RIRO) - Jarvis St	0.25	FAIL

## Table 3. Distance between Secondary Intersections (Westbound)

\*Recommended spacing is 0.5 mile in the MnDOT Access Management Manual

Only four of 14 distances between the secondary intersection along eastbound Highway 10 meet the spacing recommendation. Only four of 12 distances between the secondary intersection along westbound Highway 10 meet the spacing recommendation.

## c. Secondary Intersection Gap Analysis and Sight Distance

A full-movement, secondary intersection may be subject to future conversion to a right-in/right-out (RIRO), <sup>3</sup>/<sub>4</sub> intersection or full closure if traffic growth creates the potential for a higher-risk conflict. A gap analysis was completed for the secondary intersection along the Highway 10 corridor according to the procedure provided in the MnDOT Access Management Manual.

**Table 4** below shows the risk level for each of the secondary intersections based on conflicting and cross street traffic volumes.

Direction	Name	Right Turn Lane?	Left Turn Lane?	Туре	Conflicting Volume*	Cross Street Volume*	Risk
	Business Access (between Tungsten St & East City Limits)	N	Y	3	4578	1	High
	McKinley St	N	Y	4	3987	11	High
WB	Feldspar St	Y	Y	4	2353	10	Low
	Field Access	Ν	Y	2	2081	Unknown	Low
	153rd St (Residential Access)	N	Ν	4	2069	Unknown	Low
	Adams St	Y	Y	4	1946	Unknown	Low
	Adams St	Y	Y	4	1225	Unknown	Low
	153rd St (Residential Access)	Ν	Ν	4	1161	Unknown	Low
	Beatty St	N	Y	4	1161	Unknown	Low
	Bowers Dr	Y	Y	4	1153	20	Low
EB	Field Access	N	Y	2	1153	Unknown	Low
	Feldspar St	Y	Y	4	1427	59	Low
	Dolomite St	N	N	4	1486	2	Low
	Tungsten St	N	N	4	1868	17	Low
	Business Access (between Tungsten St & East City Limits)	Ν	Y	3	4563	16	High

## **Table 4. Secondary Intersection Gap Analysis**

\*2013 Traffic Volumes (vehicle/hour)

This shows that the Business Access is a high-risk intersection along both eastbound and westbound Highway 10. In addition, along westbound Highway 10 McKinley St is a high-risk intersection. The intersections of Alpine Dr and Jarvis St are not included in **Table 4** as they are primary intersections, however the peak hour conflicting volume at these locations would put them in the high-risk range as well. Intersection sight distance was also analyzed at the secondary intersections. All intersections met the necessary sight distance.

## d. Corner Clearance/Intersection Functional Area

Both primary and secondary intersection were analyzed to determine if recommended spacing from the intersection to the closest driveways are satisfied. **Exhibit 1** below from the MnDOT Access Management Manual shows distance measured to check for adequate corner clearance. Driveways lying within any of these distances are within the intersections functional area meaning safety may be compromised.



Exhibit 1. Corner Clearance (Figure 3.28 in the MnDOT Access Management Manual)

**Tables 5** and **6** shows the clear corner results along eastbound and westbound Highway 10. This shows that there are issues at nearly all of the intersections along Highway 10.

Direction	Name	Distance	Α	В	С	D
	I. C.	Required	650	645	75	75
	Jarvis St	Actual	525	285	85	50
	A 1	Required	650	645	75	75
	Adams St	Actual	940	100	70	575
	152nd Ave (Desidential Assess)	Required	650	645	75	75
	133rd Ave (Residential Access)	Actual	1900	1855	-	-
	Dootty St	Required	650	645	75	75
	Deatty St	Actual	475	685	225	-
	Douvon Dr	Required	650	645	75	75
	Bowers Dr	Actual	265	435	445	120
		Required	650	645	75	75
	Field Access	Actual	185	2990	-	-
	American a ED Dome	Required	650	1110	225	225
EB	EB   Armstrong EB Kamp     Ramsey Blvd	Actual	4450	4170	715	715
		Required	650	570	225	225
		Actual	2025	2760	225	1565
	Folderor St	Required	650	570	75	75
	reidspar St	Actual	2705	865	200	345
	Delemite St	Required	650	570	75	75
	Dolomite St	Actual	860	570	375	375
	Surfish Lake Dlyd	Required	650	570	225	225
	Sumisi Lake Bivd	Actual	650	400	225	225
	Tungston St	Required	650	570	75	75
		Actual	290	230	65	85
	Business Access (between	Required	650	570	75	75
	Tungsten St & East City Limits)	Actual	310	150	-	-

 Table 5. Corner Clearance Analysis Results (Eastbound, Unit: feet)

Direction	Name	Distance	Α	В	С	D
	Business Access (between	Required	650	570	75	75
	Tungsten St & East City Limits)	Actual	280	185	90	-
	Sumfish Lake Divid	Required	650	570	225	75
	Sumish Lake Bivd	Actual	245	465	395	275
	McVinlay St	Required	650	570	75	75
	McKiniey St	Actual	170	995	-	-
	Feldspar St	Required	650	570	75	75
		Actual	410	200	-	-
	Ramsey Blvd	Required	650	570	225	75
WB		Actual	210	455	170	185
11 12	Armstrong WB Ramp	Required	650	645	225	225
		Actual	575	4055	1015	1015
	152nd Ave (Desidential Access)	Required	650	645	75	75
	155rd Ave (Residential Access)	Actual	4920	370	-	-
		Required	650	645	125	125
	Alpine Dr	Actual	590	285	255	205
	A dama St	Required	650	645	75	75
	Adams St	Actual	135	810	140	365
	Lauria St	Required	650	645	75	75
	Jarvis Sl	Actual	145	850	250	280

 Table 6. Corner Clearance Analysis Results (Westbound, Unit: feet)

Due to the high number of accesses along this corridor, most locations have a least one failing spacing distance due to one or more driveways being placed too close. Future designs should attempt to relocate, combine, or eliminate driveways as recommended by the MnDOT Access Management Manual.

## e. Property Access

As part of the access considerations along Highway 10, it is important to understand the number of and placement of current accesses to each individual property. The goal for the functional classification of Highway 10 is for increased mobility, therefore direct access to Highway 10 will need to be more limited in the long-term.

There are 55 properties that have direct access onto Highway 10 with some properties having multiple Highway 10 accesses and some properties sharing the direct access onto Highway 10. **Tables 7** and **8** list each property with direct access onto Highway 10.

Business	Direct Accesses to TH 10	Does business have other accesses?	Total Accesses
Jarvis S	t to Alpine Dr		
Riverside Farms	1	Yes	3
Alpine Dr t	o Armstrong Blvd		
Residential (9404 HIGHWAY 10 NW)	1	No	1
Residential (9340 HIGHWAY 10 NW)	1	No	1
Residential (9210 HIGHWAY 10 NW)	1	No	1
Residential (9150 HIGHWAY 10 NW)	1	No	1
Residential (9135 COLLINS DR NW)	1	Yes	2
Residential (9002 HIGHWAY 10 NW)	1	No	1
Residential (8964 HIGHWAY 10 NW)	1	No	1
Residential (8940 HIGHWAY 10 NW)	1	No	1
Pearson Family Farm	2	No	2
Armstrong B	lvd to Ramsey Blv	ď	
	None		
Ramsey Blvd	to Sunfish Lake Bl	vd	
Comfort Suites	1	Yes	3
Sunfish Lake	Blvd to City Limi	ts	
Business Closed (6320 HIGHWAY 10)	1	Yes	2
Business Closed (6314 HIGHWAY 10)	1	Yes	2
Sound Waves Minnesota	1	No	1
Blueline Collision Center	1	No	1
Countryside Services	1	Yes	2
Business Closed (13601 Tungsten St)	1	Yes	2
Lano Equipment	2	No	2
Signs by RSG	1	No	1

## Table 7. Properties with Direct Access to Highway 10 (Eastbound)

## Table 8. Properties with Direct Access to Highway 10 (Westbound)

Business	Direct Accesses to TH 10	Does business have other accesses?	Total Accesses
City Limits to	Sunfish Lake Bly	/d	
E-Cig Warehouse	1	No	1
Two Rivers Vineyard & Winery	1	No	1
Outpost Bar & Grill	2	No	2
Plants and Things	1	Yes	4

Sunfish Lake B	Sunfish Lake Blvd to Ramsey Blvd			
Riostone Café	1	Yes	2	
Sunfish Properties	1	Yes	3	
Customer's Ink Tattoo	1	Yes	4	
Lisa's Catering	1	Yes	5	
ATM Network, Inc.	1	Yes	6	
Willy McCoys/ Liquor Store	1	Yes	7	
Oak Terrace Estates Office	3	No	3	
Northern Light Church	2	No	2	
Independent Auto Service	2	No	2	
Power Lodge Twin Cities	1	No	1	
Ramsey Bicycle	1	No	1	
Eddy's	2	No	2	
YorFit	2	No	2	
Fastenal	2	No	2	
Auto Source Group	1	Yes	1	
Star Auto & Truck Sales	1	No	1	
Auto Fitness and Service Center	1	No	1	
Business Closed	1	No	1	
RM Golf Carts	1	No	1	
Motors On Ten	1	No	1	
Hirshfield's Ramsey	1	Yes	2	
Ramsey Blvd	to Armstrong Blv	<u>r</u> d	<u>.</u>	
Burger King	1	Yes	2	
Tuff Shed	1	No	1	
Ferrellgas	1	No	1	
RV World	1	No	1	
AmeriGas	1	No	1	
Anoka-Ramsey Farm & Garden	1	No	1	
M&G Trailer	1	No	1	
EZ Auto Sales	1	No	1	
Armstrong Blvd to Alpine Dr				
Skeeter Boat Center	1	No	1	
Alpine Dr to Jarvis St				
Engels Auto	1	No	1	
Top Shelf Tires	1	No	1	
Amazon Auto	2	No	2	

## Table 8. Properties with Direct Access to Highway 10 (Westbound) [continued]

**Table 9** shows how many total accesses there are between each of the primary intersections along the corridor.

Primary Intersections	Miles	Total Accesses	Accesses per mile
Jarvis St to Alpine Dr	0.44	9	20.5
Alpine Dr to Bowers Dr	1.01	10	9.9
Bowers Dr to Armstrong Blvd	0.9	3	3.3
Armstrong Blvd to Ramsey Blvd	1.13	12	10.6
Ramsey Blvd to Sunfish Lake Blvd	1.09	20	18.3
Sunfish Lake Blvd to City Limits	0.47	19	40.4
Total	5.04	73	14.5

## Table 9. Accesses Between Primary Intersections

**Table 9** shows that the areas with the most accesses are from Ramsey Blvd to Sunfish Lake Blvd and from Sunfish Lake Blvd to the Ramsey City limits. From Sunfish Lake Blvd to the Ramsey City limits there are 19 accesses in less than ½ mile. Figure 1 in Appendix A shows the accesses per mile throughout the corridor. Figures 2A through 2F in Appendix A shows each of the access locations, which meet requirements and which need review.

## C. Safety Analysis

## a. Intersection Crashes (2013-2017)

A crash review was completed for the intersections in the project area for the previous five years (2013-2017). The following intersections had a critical index within the normal range when compared to similar intersections statewide. The crash worksheet for each intersection can be found in **Appendix B**. The latest available crash rates are from 2015 and were used for comparison purposes.

- TH 10 at Jarvis St
- TH 10 at Alpine Dr
- Armstrong Blvd at Bunker Lake Blvd
- Armstrong Blvd at 147<sup>th</sup> Ave
- Ramsey Blvd at Bunker Lake Blvd
- Ramsey Blvd at Sunwood Dr
- Sunfish Lake Blvd at Bunker Lake Blvd
- Sunfish Lake Blvd at McKinley St
- Sunfish Lake Blvd at Riverdale Dr

The construction of the TH 10 and Armstrong Blvd interchange was completed in 2015. Since then, there has been one crash at the WB Ramp and no crashes at the EB Ramp. The crash that occurred was a collision with a sign and was property damage only. No crash worksheet was created for these intersections as only two years of crash data are available since construction. The following locations have a critical index above the normal operating range and are described in more detail.

## Armstrong Blvd at Alpine Dr

Over the past five years there have been 15 crashes that have occurred at the intersection of Armstrong Blvd and Alpine Dr. **Table 10** summarizes the crash types that occurred at the intersection.

Crash Type	Frequency
Right Angle	8
Left Turn	4
Rear End	2
Bicycle	1

## Table 10. Armstrong Blvd at Alpine Dr Crash Type

**Table 10** shows that right angle crashes were the most common at the intersection, three of which involved avoiding a pedestrian. There was one bicycle crash that resulted in a non-incapacitating injury. The crash severity of the crashes reported at the intersection are shown in **Table 11**.

Crash Severity	Frequency
Fatal	0
Incapacitating Injury	1
Non-Incapacitating Injury	4
Possible Injury	3
Property Damage Only	7

## Table 11. Armstrong Blvd at Alpine Dr Crash Severity

The observed crash rate at Armstrong Blvd and Alpine Dr was found to be 1.04. This is over five times higher than the statewide average for similar intersections of 0.18. A critical index at or greater than 1 indicates that the intersection is operating outside the normal range when compared to intersections of similar volumes, traffic control and speeds. The critical index was found to be 2.04 which shows that the intersection is operating outside the normal range. The number of crashes at this intersection would need to be reduced by seven over a five -year range to perform within the normal range. The fatal and serious injury crash critical index was found to be 1.21 which shows that the intersection is operating outside the normal range. The Armstrong Blvd and Alpine Dr intersection crash worksheet can be found in **Appendix B**.

## TH 10 at Sunfish Lake Blvd

Over the past five years there have been 89 crashes that have occurred at the intersection of TH 10 and Sunfish Lake Blvd. **Table 12** summarizes the crash types that occurred at the intersection.

Crash Type	Frequency
Rear End	71
Sideswipe Passing	9
Ran off Road	4
Right Angle	3
Left Turn	2

## Table 12. TH 10 at Sunfish Lake Blvd Crash Type

**Table 12** shows that rear end crashes were the most common at the intersection. 64 of the 71 rear end crashes occurred along Highway 10. These rear ends are likely caused from excessive queuing at the signal. The crash severity of the crashes reported at the intersection are shown in **Table 13**.

Crash Severity	Frequency
Fatal	0
Incapacitating Injury	1
Non-Incapacitating Injury	7
Possible Injury	18
Property Damage Only	63

## Table 13. TH 10 at Sunfish Lake Blvd Crash Severity

The observed crash rate at TH 10 and Sunfish Lake Blvd was found to be 0.89. The statewide average for similar intersections is 0.45 which indicates that the crash rate at TH 10 and Sunfish Lake Blvd is almost twice the average. The critical index was found to be 1.41 which shows that the intersection is operating outside the normal range when compared to similar intersections statewide. The number of crashes at this intersection would need to be reduced by 25 crashes over a five-year period to preform within the normal range.

The crash issue at TH 10 and Sunfish Lake Blvd is only anticipated to get worse with the completion of the grade separations of TH 10 at Fairoak Ave and Thurston Ave in Anoka. A five-year analysis (2011-2015) at the intersections of TH 10 at Fairoak Ave and Thurston Ave was completed with the TH 10 Improvements project. This analysis showed that there were 192 rear end crashes at Fairoak Ave and 76 rear end crashes at Thurston Avenue. Once the project in Anoka is completed Sunfish Lake Blvd will be the first signal for westbound traffic which would likely shift these rear end crashes to the TH 10 at Sunfish Lake Blvd intersection crash worksheet can be found in **Appendix B**.

## TH 10 at Ramsey Blvd

Over the past five years there have been 51 crashes that have occurred at the intersection of TH 10 and Ramsey Blvd. **Table 14** below summarizes the crash types that occurred at the intersection.

Crash Type	Frequency
Rear End	43
Right Angle	3
Ran off Road	2
Left Turn	1
Sideswipe Passing	1
Other	1

## Table 14. TH 10 and Ramsey Blvd Crash Type

**Table 14** shows that rear end crashes were the most common at the intersection. 37 of the 43 rear end crashes occurred along Highway 10. The crash severity of the crashes reported at the intersection are shown in **Table 15**.

Crash Severity	Frequency
Fatal	0
Incapacitating Injury	1
Non-Incapacitating Injury	4
Possible Injury	11
Property Damage Only	35

## Table 15. TH 10 and Ramsey Blvd Crash Severity

The observed crash rate at TH 10 and Ramsey Blvd was found to be 0.58. This is higher than the statewide average for similar intersections of 0.45. The critical index was found to be 0.91 which shows that the intersection is operating within the normal range. However, an additional six crashes over a five-year range would cause the intersection to perform outside the normal range. The TH 10 at Ramsey Blvd intersection crash worksheet can be found in **Appendix B**.

## b. Segment Crashes (2013-2017)

A five-year crash analysis was completed for the TH 10 corridor. The corridor was split into two segments. The first segment was analyzed between Jarvis St and Armstrong Blvd and the second segment was analyzed between Armstrong Blvd and the east city limits of Ramsey.

There were a total of 59 crashes along TH 10 between Jarvis St and Armstrong Blvd from 2013 and 2017. **Table 16** below show the crash type. Rear end crashes were the most common accounting for 139 of the 218 total crashes. 73% of the rear end crashes occurred at the TH 10 at the Ramsey Blvd and Sunfish Lake Blvd signals.

Crash Type	Frequency
Rear End	19
Other	7
Ran off Road	12
Sideswipe Passing	6
Right Angle	12
Head On	1
Left Turn	1
Sideswipe Opposing	1

## Table 16. TH 10 from Jarvis St to Armstrong Blvd Segment Crash Type

The crash severity of the crashes reported at the intersection are shown in Table 17.

## Table 17. TH 10 from Jarvis St to Armstrong Blvd Segment Crash Severity

<b>Crash Severity</b>	Frequency
Fatal	0
Incapacitating Injury	3
Non-Incapacitating Injury	6
Possible Injury	13
Property Damage Only	37

The observed crash rate was found to be 0.4 where the statewide average for a rural expressway is 0.66. The critical index was found to be 0.48 which shows that it is operating within the normal range for similar segments statewide.

There were a total of 218 crashes along TH 10 between Armstrong Blvd and the east Ramsey city limits. from 2013 and 2017. **Table 18** below show the crash type. Rear end crashes were the most common accounting for 139 of the 218 total crashes. 73% of the rear end crashes occurred at the TH 10 at the Ramsey Blvd and Sunfish Lake Blvd signals.

Crash Type	Frequency
Rear End	139
Other	26
Ran off Road	17
Sideswipe Passing	19
Right Angle	11
Head On	3
Left Turn	2
Sideswipe Opposing	1

Table 18, TH	I 10 from Armstrong	Blvd to the East C	ity Limits Segment	Crash Type
	i io nom monong	Divu to the Last C	ity Linnes Segment	Crash rype

The crash severity of the crashes reported at the intersection are shown in Table 19.

Table 19. TH 10 from	Armstrong Blvd	to the East City	v Limits Segment	<b>Crash Severity</b>
	in motions bit a	to the Bast City	, Limits Segment	Crash Severies

<b>Crash Severity</b>	Frequency
Fatal	0
Incapacitating Injury	3
Non-Incapacitating Injury	17
Possible Injury	43
Property Damage Only	155

The observed crash rate was found to be 0.90 where the statewide average for an urban expressway is 1.64. The critical index was found to be 0.49 which shows that it is operating within the normal range for similar segments statewide.

Although both segments are currently operating within the normal range, as previously stated with the completion of the project in Anoka a significant amount of rear end crashes currently occurring in Anoka are anticipated to be shifted to Ramsey. The segment crash worksheets can be found in **Appendix B**.

## c. Fatal Crashes (2008-2017)

A ten-year crash analysis was completed for fatal crashes throughout the project area. It was found there were five fatal crashes. Two of the fatalities were vehicular crashes. One was a left turn crash located at the intersection of TH 10 at Alpine Drive. The other was a right-angle crash at the intersection of TH 10 and McKinley St. There were three fatal pedestrian crashes between 2008 and 2017. These crashes took place at the intersections of TH 10 and Ramsey Blvd, TH 10 at Sunfish Lake Blvd and at the business

access along TH 10 between Sunfish Lake Blvd and Thurston Avenue that provides access to Two Rivers Vineyard & Winery, Signs by RSG and Lano Equipment.

## d. Bike/Pedestrian

Bike and pedestrian crashes were analyzed over a five-year period (2013-2017). There was one nonincapacitating injury pedestrian crash at the intersection of Ramsey Blvd and Bunker Lake Blvd. There were two bicycle crashes recorded. One was a property damage crash at the intersection of Sunfish Lake Blvd and Bunker Lake Blvd and the other was a non-incapacitating injury crash at the intersection of Armstrong Blvd and Alpine Dr. Additionally, there were three right angle crashes at Armstrong Blvd and Alpine Dr that were noted to be caused by vehicles avoiding hitting a pedestrian in the crosswalk.

Figure 3 in Appendix A summarizes all of the crashes in the project area.

## **D.** Traffic Volumes

**Figure 4** in **Appendix A** shows the existing peak hour turning movement counts. Existing traffic volumes for the area were collected in May of 2018 for all intersections except TH 10 at Sunfish Lake Blvd and TH 10 at Ramsey Blvd which were collected in May 2017 for the TH 10 Improvements project in Anoka. The AM and PM peak periods were found to be 7-8 AM and 4:15-5:15 PM, respectively.

## **E.** Operations

A level of service (LOS) analysis of the peak hours was completed using the existing turning movement counts in VISSIM. The LOS results are based on average delay per vehicle as calculated by the 2010 Highway Capacity Manual (HCM), which defines the level of service, based on control delay. Control delay is the delay experienced by vehicles slowing down as they are approaching the intersection, the wait time at the intersection, and the time for the vehicle to speed up through the intersection and enter into the traffic stream. The average intersection control delay is a volume weighted average of delay experienced by all motorists entering the intersection on all intersection approaches. Intersections and each intersection approach are given a ranking from LOS A through LOS F. LOS A indicates the best traffic operation, with vehicles experiencing minimal delays. LOS A through D is generally perceived to be acceptable to drivers. LOS E indicates that an intersection is operating at, or very near, its capacity and that drivers experience considerable delays. LOS F indicates an intersection where demand exceeds capacity and drivers experience substantial delays.

The existing AM and PM peak traffic volumes were analyzed with the current geometry along Highway 10. Operational results for the major intersections in the project area along Highway 10 are shown in **Table 18** below. The queues highlighted red extend beyond turn lanes and/or block driveways. **Tables A1 and A2** in **Appendix C** show the demand and modeled volumes, percentage error, GEH statistic, delay and queues of each movement for all of the intersections that were analyzed. The GEH statistic is a measure to compare volume demand versus actual volume modeled. The formula for the GEH statistic is shown below.

$$GEH = \sqrt{rac{2(M-C)^2}{M+C}}$$

M = Output traffic volume from the simulation model measured in vehicles per hour (VPH) C = Input traffic volume (VPH)

This measure is able to compare large ranges in volume. Using a ten percent tolerance, which may be adequate for large volume movements, would only allow for a movement with 40 cars to vary by four vehicles. A GEH statistic below five shows the volume modeled is acceptable, from five to ten there may be errors in the model and over ten is considered unacceptable.

	Peak Intersection		Maximum Delay- LOS**		Limiting Movement ***	Max Approach Queue			
Location Hou		Delay- LOS				Direction	Average Queue (ft)	Max Queue (ft)	
TH 10 at Jarvis St	AM	3	Α	157	F	SBT	NBL/T/R	25	125
Stop Controlled	PM	3	Α	127	F	SBT	SBL/T/R	25	150
TH 10 at Alpine St	AM	2	Α	25	D	SBL	SBL/R	25	100
Stop Controlled	PM	5	Α	63	F	SBL	EBL	50	175
Armstrong Blvd at Alpine St.	AM	5	Α	28	D	WBL	EBR	25	150
Stop Controlled	PM	10	В	30	D	WBL	NBL	25	150
Armstrong Blvd at Bunker Lake Blvd	AM	14	В	41	D	EBT	SBL	50	275
Signalized Intersection	PM	12	В	40	D	NBL	NBT	25	150
Armstrong Blvd at 147th St	AM	7	Α	29	С	EBT	SBL	25	100
Signalized Intersection	PM	12	В	26	С	EBL	WBR	25	150
WB TH 10 Ramps at Armstrong Blvd	AM	1	Α	19	В	NBL	SBT/SBR	25	75
Signalized Intersection	PM	16	В	43	D	WBL	SBR	25	150
EB TH 10 Ramps at Armstrong Blvd	AM	3	Α	16	С	EBL	EBL	25	150
Stop Controlled	PM	7	Α	14	В	EBL/EBT	EBL	25	150
Bunker Lake Blvd at Ramsey Blvd	AM	20	С	36	D	EBL	SBL/SBT/EBT	25	150
Signalized Intersection	PM	20	В	35	С	SBL	WBT	50	225
Sunwood Dr at Ramsey Blvd	AM	21	С	40	D	NBL	NBL	25	250
Signalized Intersection	PM	25	С	45	D	NBL	NBL	25	225
TH 10 at Ramsey Blvd	AM	28	С	391	F	SBT	EBT	125	875
Signalized Intersection	PM	25	С	131	F	SBL	WBT	50	500
Bunker Lake Blvd at Sunfish Lake Blvd	AM	29	С	43	D	EBT	EBT	75	400
Signalized Intersection	PM	23	С	39	D	EBT	WBT	50	250
McKinley St. at Sunfish Lake Blvd	AM	3	Α	25	С	WBL	WBR	25	125
Stop Controlled	PM	20	С	113	F	WBL	WBT	125	600
TH 10 at Sunfish Lake Blvd	AM	27	С	125	F	NBL	WBT	125	725
Signalized Intersection	PM	38	D	152	F	SBL	WBT	275	2250
Riverdale Dr at Sunfish Lake Blvd	AM	2	Α	10	Α	SBL	SBL/R	25	75
Stop Controlled	PM	6	Α	11	В	SBL	SBL/R	25	100

 Table 20. Existing (2018) No Build Operational Analysis

\*Delay in seconds per vehicle

\*\*Maximum delay and LOS on any approach and/or movement

\*\*\*Limiting Movement is the highest delay approach

## AM Delay

- Currently all intersections operate well with LOS C or better during the AM peak hour.
- TH 10 at Jarvis St
  - All northbound movements operate with failing LOS
  - o Southbound left and through movements operate with failing LOS
- TH 10 at Ramsey Blvd
  - o Northbound, southbound and eastbound left turn movements operate with failing LOS
  - o Northbound and southbound through movements operate with failing LOS
  - o Average delay is over two minutes per vehicles for the southbound approach
- TH 10 at Sunfish Lake Blvd
  - o Northbound, southbound, and westbound left turn movements operate with failing LOS
  - Southbound through movement operate with failing LOS
  - o Average delay is 102 sec/veh for the southbound approach

## PM Delay

- Currently all intersections operate well with LOS D or better during the PM peak hour.
- TH 10 at Jarvis St
  - The left and through movements for the north and southbound approaches operate with failing LOS
- TH 10 at Ramsey Blvd
  - All left turn movements operate with failing LOS
  - o Northbound and southbound through movements operate with failing LOS
  - Average delay is 111 sec/veh for the southbound approach
- Sunfish Lake Blvd at McKinley St.
  - o Westbound left and right turn movements operate with failing LOS
  - Average delay is 101 sec/veh for the westbound approach
- TH 10 at Sunfish Lake Blvd
  - All southbound movements operate with failing LOS
  - o Northbound through movement operates with failing LOS
  - o Eastbound and westbound left turn movements operate with failing LOS
  - Average delay is 142 sec/veh for the southbound approach
  - Average delay is over two minutes for the southbound, eastbound and westbound left turn movements

## Queues

- Queues are acceptable during both peak hours except for the following intersections.
- TH 10 at Ramsey Blvd
  - Maximum eastbound through queues block both turn lanes during the AM peak hour.
  - Maximum eastbound and westbound through queues block the right turn lane and driveways during the PM peak hour.
- Bunker Lake Blvd at Sunfish Lake Blvd.
  - Maximum eastbound queues block the right turn lane during the AM peak hour.
  - Queues are acceptable during the PM peak hour.
- McKinley St at Sunfish Lake Blvd
  - Maximum westbound queues block driveways during both peak hours.
- TH 10 at Sunfish Lake Blvd
  - Maximum eastbound queues block the right turn lane during both peak hours.
  - Maximum westbound through queues block turn lanes during the both peak hours.
  - Maximum southbound queues extend beyond the channelized turn lane and the railroad crossing during the PM peak hour.

The failing side street movements during both peak hours at the intersection of TH 10 and Jarvis St show that vehicles are not finding adequate gaps in traffic. The gap time vehicles take was decreased in VISSIM from what is recommended in the AASHTO Green Book in order get more cars through the intersection to match the turning movement count taken in May 2018. With the recommended gap times, not enough traffic was getting through the intersection in the peak hours which shows that traffic is taking shorter gaps. Although there is not a current safety issue shown through the crash analysis at this intersection, the traffic analysis shows that these movements are putting vehicles at higher risk as vehicles are observed to take shorter gaps due to excessive delay.

Figures 5 and 6 in Appendix A summarizes the existing traffic operations.

## F. Speed and Congestion

Peak hour travel time runs were completed the same week intersection counts were completed throughout the project area in order to ensure the traffic modeling is accurate. Tables 21 and 22 below show the average speeds that were recorded:

Table 21. Ingilway 10 Lastbound Speeds						
Highway 10 Eastbound Locations	Average Speed (MPH)					
	AM	PM				
Jarvis St to Alpine Dr	55	57				
Alpine Dr to Armstrong Blvd	66	71				
Armstrong Blvd to Ramsey Blvd	40	42				
Ramsey Blvd to Sunfish Lake Blvd	54	45				

Table 21. Highway 10 Eastbound Speeds			
hway 10 Easthound Locations	Average Sp	peed (M	
liway 10 Eastbound Locations	434	DI	

Tuble 220 Highway 10 VVC	stoound sp	eeus		
Highway 10 Westhound Logations	Average Speed (MPH)			
Highway 10 westbound Locations	AM	PM		
Alpine Dr to Jarvis St	47*	61		
Armstrong Blvd to Alpine Dr	55*	68		
Ramsey Blvd to Armstrong Blvd	54	54		
Sunfish Lake Blvd to Ramsey Blvd	52	40		

Table 22. Highway	10	Westbound	Speeds
-------------------	----	-----------	--------

\*Speeds are lower during the AM peak hour as westbound traffic was reduced to one lane from Bowers Dr to Jarvis St

Excessive queuing was observed along westbound Highway 10 at Sunfish Lake Blvd. This is consistent with what the traffic modeling showed.

## G. Freight and Transit

The BNSF railroad runs parallel to Highway 10 throughout the corridor. In some locations the railroad is within 1/8 of a mile to Highway 10. This is the busiest segment of railroad in the entire state with 58 to 80 freight trains passing through every day. The maximum capacity for this rail line is 104 trains per day. The freight trains pass through at speeds up to 79 MPH. The average length of a freight train is 2.6 miles. Northstar runs 12 commuter trains per day (six in each direction) and more during special events. Amtrak runs two trains per day.

Based on schedules and train observations, during the AM peak hour two Northstar trains were modeled passing through the corridor and one freight train was modeled. During the PM peak hour three Northstar trains were modeled to pass through the corridor and three freight trains. Figure 7 in Appendix A shows the maximum peak hour queuing when a train is present. This shows that during the PM peak hour, queues along both northbound Ramsey Blvd and Sunfish Lake Blvd extend onto Highway 10.

## H. 2025 and 2045 No Build Analysis

A no build analysis was completed to determine operations if no changes from existing were made throughout project area. It was assumed that the TH 10 project in Anoka would be completed which makes TH 10 at Sunfish Lake Blvd the first signal along westbound TH 10. The 2025/2045 daily traffic

forecasts were developed for the major roadways in the study area using the latest Twin Cities Regional Model - Activity Based Model (ABM). The traffic forecast assumptions, methodology and results are documented in the *Highway 10 Corridor Improvements Study – Daily Traffic Forecasts Memorandum on August 7, 2018.* The daily traffic growth factors were applied to the existing peak hour counts to develop turning movement traffic forecasts for 2025/2045. Manual adjustments were made during the process to balance the different growth from different approaches. Figures 8 and 9 in Appendix A show the final forecasted turning movement counts for 2025 and 2045, respectively. Table 23 summarizes the 2025 no build analysis. Tables A3 and A4 in Appendix C show the detailed results.

	Peak	Intersection		Maxi	mum	Limiting	Max	Approach Q	ueue
Location	Hour	Delay	/- LOS	Delay- LOS**		Movement ***	Direction	Average Queue (ft)	Max Queue (ft)
TH 10 at Jarvis St	AM	26	D	1602	F	NBR	NBL/T/R	700	1025
Stop Controlled	PM	17	С	1347	F	NBL	NBR	675	1000
TH 10 at Alpine St	AM	3	Α	29	D	SBL	SBL/R	25	125
Stop Controlled	PM	10	В	147	F	SBL	EBL/SBL	50	275
Armstrong Blvd at Alpine St.	AM	24	С	180	F	WBR	EBR	75	400
Stop Controlled	PM	11	В	25	D	EBL	EBR	25	200
Armstrong Blvd at Bunker Lake Blvd	AM	24	С	49	D	EBL	SBL	125	575
Signalized Intersection	PM	11	В	40	D	EBL/EBT	NBT/SBL	25	125
Armstrong Blvd at 147th St	AM	9	Α	30	С	NBL	SBT	25	150
Signalized Intersection	PM	11	В	26	С	EBL	NBT	25	150
WB TH 10 Ramps at Armstrong Blvd	AM	6	Α	42	D	WBL	SBR	25	150
Signalized Intersection	PM	4	Α	41	D	WBL	WBL	25	200
EB TH 10 Ramps at Armstrong Blvd	AM	3	Α	19	С	EBL	EBL	25	175
Stop Controlled	PM	3	Α	32	D	EBL	EBL	50	300
Bunker Lake Blvd at Ramsey Blvd	AM	21	С	37	D	WBL	EBT	50	150
Signalized Intersection	PM	23	С	39	D	WBL	WBT	50	225
Sunwood Dr at Ramsey Blvd	AM	23	С	43	D	NBL	NBL	50	425
Signalized Intersection	PM	26	С	45	D	NBL	NBL	25	250
TH 10 at Ramsey Blvd	AM	33	С	480	F	SBT	EBT	150	1050
Signalized Intersection	PM	27	С	120	F	SBL	WBT	100	1300
Bunker Lake Blvd at Sunfish Lake Blvd	AM	29	С	43	D	EBT	EBT	75	450
Signalized Intersection	PM	24	С	39	D	EBT	WBT	50	275
McKinley St. at Sunfish Lake Blvd	AM	3	Α	27	D	WBL	WBR	25	125
Stop Controlled	PM	138	F	726	F	WBL	WBR	1000	1950
TH 10 at Sunfish Lake Blvd	AM	32	С	115	F	SBL	WBT	150	850
Signalized Intersection	PM	84	F	301	F	SBL	WBT	1350	3800
Riverdale Dr at Sunfish Lake Blvd	AM	2	А	10	В	SBL/R	SBL/R	25	75
Stop Controlled	PM	5	Α	10	В	SBL	SBL/R	25	150

Table 23	3. 2025 N	o Build O	nerational	Analysis
	J. 202J II	o Duniu O	$p_{c1}a_{c1}o_{11}a_{1}$	7 MIAI V 515

\*Delay in seconds per vehicle

\*\*Maximum delay and LOS on any approach and/or movement

\*\*\*Limiting Movement is the highest delay approach

## 2025 AM Delay

- All intersections perform with a LOS D or better in the 2025 AM peak hour.
- TH 10 at Jarvis St
  - o Northbound approach operates with over 24 minutes of delay on average per vehicle
  - o Southbound approach operates with over six minutes of delay on average per vehicle
  - o Westbound left turn movement operates with a failing LOS
- Alpine Dr at Armstrong Blvd
  - Westbound approach operates with a failing LOS
  - o Eastbound left turn movement operates with a failing LOS

- TH 10 at Ramsey Blvd
  - o Northbound, southbound and eastbound left turn movements operate with failing LOS
  - Northbound and southbound through movements operate with failing LOS
- TH 10 at Sunfish Lake Blvd
  - o Northbound, southbound and westbound left turn movements operate with failing LOS
  - o Northbound and southbound through movements operate with failing LOS

## 2025 PM Delay

- All intersections but the following operate well with LOS C or better during the 2025 PM peak hour.
  - o Sunfish Lake Blvd at McKinley St
  - TH 10 at Sunfish Lake Blvd
- TH 10 at Jarvis St
  - o Northbound approach operates with over 16 minutes of delay on average per vehicle
  - o Southbound approach operates with over two minutes of delay on average per vehicle
  - o Eastbound left turn movement operates with failing LOS
- TH 10 at Alpine Dr
  - Southbound left turn movement operates with over two minutes of delay on average per vehicle
- TH 10 at Ramsey Blvd
  - o All left turn movements operate with failing LOS
  - o Northbound and southbound through movements operate with failing LOS
- Sunfish Lake Blvd at McKinley St
  - The westbound approach operates with over 11 minutes of delay on average per vehicle
  - o Eastbound left turn movement operates with failing LOS
- TH 10 at Sunfish Lake Blvd
  - All left turn movements operate with failing LOS
  - o Northbound and southbound through movements operate with failing LOS
  - o Southbound right movement operates with failing LOS
  - o Southbound approach operates with nearly five minutes of delay on average per vehicle

2025 Queuing Issues

- TH 10 at Jarvis St
  - Maximum northbound queue extends past all current businesses on Cleveland St during both peak hours
- TH 10 at Alpine Dr
  - Maximum southbound queues extend beyond the channelized turn lanes during the PM peak hour
- Armstrong Blvd at Bunker Lake Blvd
  - Maximum southbound left queue extends beyond the channelized left turn lane during the AM peak hour
- Armstrong Blvd at EB TH 10 Ramp
  - Maximum eastbound left queue extends beyond the channelized turn lane during the PM peak hour
- Ramsey Blvd at Sunwood Dr
  - Maximum westbound shared through-right turn queue blocks the left turn lane during the AM peak hour

• TH 10 at Ramsey Blvd

٠

- Maximum eastbound queues block both turn lanes during both peak hours
- o Maximum westbound queues block both turn lanes during the PM peak hour
- Sunfish Lake Blvd at McKinley St
  - o Maximum westbound queues extend past Radium St during the PM peak hour
- TH 10 at Sunfish Lake Blvd
  - o Eastbound maximum queue extends past turn lanes during the AM peak hour
  - Westbound maximum queue extends past turn lanes during the AM peak hour and the average queues extend past both turn lanes during the PM peak hour
  - Northbound right turn queue extends beyond the channelized right turn lane during the AM peak hour
  - o Southbound left turn queue extends past McKinley St during the PM peak hour

**Figures 10** and **11** in **Appendix A** summarizes the 2025 no build traffic operations and **Figure 12** in **Appendix A** shows the 2025 no build maximum peak hour queuing when a train is present.

Table 24 summarizes the 2045 no build analysis. Tables A5 and A6 in Appendix C show the detailed results.

	Peak	Inters	ection	Maximum		Maximum		Maximum		Limiting	Max Approach Queue		
Location	Hour	Delay	Delay- LOS		LOS**	Movement	Direction	Average	Max				
								Queue (ft)	Queue (ft)				
TH 10 at Jarvis St	AM	211	F	3749	F	WBL	WBL	10950	18975				
Stop Controlled	PM	82	F	1937	F	NBL	WBT	1750	2450				
TH 10 at Alpine St	AM	250	F	775	F	WBT	WBT	6250	10900				
Stop Controlled	PM	170	F	248	F	WBR	WBT	4650	10325				
Armstrong Blvd at Alpine St.	AM	184	F	709	F	EBL	WBR	2225	3650				
Stop Controlled	PM	115	F	747	F	EBL	EBR	1625	2700				
Armstrong Blvd at Bunker Lake Blvd	AM	30	С	59	E	NBL	SBL	200	775				
Signalized Intersection	PM	20	В	57	E	NBL	WBR	75	525				
Armstrong Blvd at 147th St	AM	12	В	30	С	EBT	SBT	25	250				
Signalized Intersection	PM	15	В	33	С	EBT	WBR	25	200				
WB TH 10 Ramps at Armstrong Blvd	AM	14	В	39	D	WBL	SBT/SBR	25	200				
Signalized Intersection	PM	17	В	40	D	WBL	SBR	25	300				
EB TH 10 Ramps at Armstrong Blvd	AM	31	D	114	F	EBL	EBL	350	1975				
Stop Controlled	PM	95	F	744	F	EBL	EBL	1000	2700				
Bunker Lake Blvd at Ramsey Blvd	AM	24	С	43	D	WBL	SBT	50	275				
Signalized Intersection	PM	23	С	38	D	NBL	WBT	50	200				
Sunwood Dr at Ramsey Blvd	AM	37	D	71	E	SBT	NBL	50	400				
Signalized Intersection	PM	27	С	49	D	NBL	WBT/R	50	300				
TH 10 at Ramsey Blvd	AM	164	F	793	F	NBR	EBT	4000	6000				
Signalized Intersection	PM	36	D	160	F	SBL	WBT	100	1075				
Bunker Lake Blvd at Sunfish Lake Blvd	AM	34	С	57	E	NBL	EBT	100	550				
Signalized Intersection	PM	26	С	37	D	EBT	WBT	75	350				
McKinley St. at Sunfish Lake Blvd	AM	4	Α	35	D	WBL	WBR	25	150				
Stop Controlled	PM	192	F	1239	F	WBR	WBR	1850	1875				
TH 10 at Sunfish Lake Blvd	AM	86	F	310	F	NBT	EBT	4975	6100				
Signalized Intersection	PM	130	F	270	F	WBL	WBT	19150	20225				
Riverdale Dr at Sunfish Lake Blvd	AM	126	F	174	F	EBL	EBL	350	550				
Stop Controlled	PM	8	Α	14	В	SBL/R	SBL/R	25	200				

Table 24. 2045 No Build Operational Analysis

\*Delay in seconds per vehicle

\*\*Maximum delay and LOS on any approach and/or movement

\*\*\*Limiting Movement is the highest delay approach

Name: Existing Traffic Conditions

Date: April 30, 2019

Page: 22

## 2045 AM Delay

- The following intersections operate with LOS F during the 2045 AM peak hour:
  - o TH 10 at Jarvis St
  - TH 10 at Alpine Dr
  - Armstrong Blvd at Alpine Dr
  - TH 10 at Ramsey Blvd
  - TH 10 at Sunfish Lake Blvd
  - o Sunfish Lake Blvd at Riverdale Dr
- All other intersection operates with LOS D or better
- TH 10 at Jarvis St
  - No vehicles on the northbound or southbound approaches were able to go during the entire peak hour
  - All approaches operate with a failing LOS
- Alpine Dr at Armstrong Blvd
  - The eastbound and westbound approaches operate with a failing LOS
  - Eastbound approach operates with over 10 minutes of delay on average per vehicle
- TH 10 at Ramsey Blvd
  - All movements for the northbound, southbound, and eastbound traffic operate with a failing LOS
  - Westbound left turn movement operates with a failing LOS
  - o Northbound approach operates with over 10 minutes of delay on average per vehicle
  - o Southbound approach operates with over five minutes of delay on average per vehicle
  - Eastbound approach operates with over two minutes of delay on average per vehicle
- TH 10 at Sunfish Lake Blvd
  - o All eastbound and northbound movements operate with failing LOS
  - o The southbound left and westbound left movements operate with failing LOS
  - o Northbound approach average delay is over four minutes per vehicle
- Sunfish Lake Blvd at Riverdale Dr
  - Eastbound approach fails due to queues extending through the intersection from the northbound approach at TH 10 and Sunfish Lake Blvd

## 2045 PM Delay

- The following intersections operate with LOS F during the 2045 PM peak hour:
  - o TH 10 at Jarvis St
  - TH 10 at Alpine Dr
  - Armstrong Blvd at Alpine Dr
  - EB TH 10 Ramp at Armstrong Blvd
  - Sunfish Lake Blvd at McKinley St
  - TH 10 at Sunfish Lake Blvd
- All other intersection operates with LOS D or better
- TH 10 at Jarvis St
  - Northbound and southbound approaches operate with over 29 minutes of delay on average per vehicle
  - o Eastbound and westbound left turn movements operate with failing LOS
- TH 10 at Alpine Dr
  - o Westbound and southbound approaches operate with failing LOS
- TH 10 EB Ramp at Armstrong
  - o Eastbound approach operates with over four minutes of delay on average per vehicle

- TH 10 at Ramsey Blvd
  - o The northbound and southbound left and through movements operate with failing LOS
  - Eastbound left movement operates with failing LOS
  - Sunfish Lake Blvd at McKinley St
    - o Eastbound and westbound approaches operate with failing LOS
    - o Westbound approach operates with over 20 minutes of delay on average per vehicle
- TH 10 at Sunfish Lake Blvd
  - o All left turn movements operate with failing LOS
  - o Northbound, southbound, and westbound through movements operate with failing LOS
  - o Westbound right movement operates with failing LOS

## 2045 Queueing Issues

٠

- TH 10 at Jarvis
  - Queues on all approaches are extensive
  - o Maximum westbound left turn queue extends over three miles during the AM peak hour
  - Average eastbound queues block both turn lanes during both peak hours
  - Maximum northbound queues extend past all current businesses on Cleveland St during both peak hours
  - o Maximum southbound queues extend past the railroad tracks during both peak hours
- TH 10 at Alpine Dr
  - Average queues on all approaches are extensive
- Armstrong Blvd at Alpine Dr
  - Maximum eastbound queue extends over half a mile during both peak hours
- Armstrong Blvd at Bunker Lake Blvd
  - Maximum southbound left turn queues extend beyond channelized turn lane during the AM peak hour.
  - Maximum westbound right turn queues extend beyond the channelized turn lane during the PM peak hour
- Armstrong Blvd at EB TH 10 Ramp
  - Maximum eastbound left queues extend onto the mainline blocking TH 10 through traffic during both peak hours
- Ramsey Blvd at Sunwood Dr
  - Maximum westbound through queues block the left turn lane during both peak hours
  - o Maximum eastbound through queues block the left turn lane during the PM peak hour
- TH 10 at Ramsey Blvd
  - Maximum eastbound queue extends over one mile during the AM peak hour and blocks both turn lanes during the PM peak hour
  - Maximum westbound queues block both turn lanes during the PM peak hour
  - o Maximum northbound through queue blocks turn lanes during the AM peak hour
- Sunfish Lake Blvd at Bunker Lake Blvd
  - o Maximum eastbound through queue blocks turn lanes during the AM peak hour
- Sunfish Lake Blvd at McKinley St
  - o Maximum westbound queues extend past Radium St during the PM peak hour
- TH 10 at Sunfish Lake Blvd
  - Eastbound and eastbound maximum queues block turn lanes during both peak hours
  - The maximum westbound through queue extends over three miles during the PM peak hour
  - Maximum eastbound through queue extends beyond Ramsey Blvd during the AM peak hour.

- Maximum northbound queues extend beyond the turn lanes and onto Riverdale Dr during the AM peak hour
- o Maximum southbound left turn queues extend past McKinley St during the PM peak hour

**Figures 13** and **14** in **Appendix A** summarizes the 2045 no build traffic operations and **Figure 15** in **Appendix A** shows the 2045 no build maximum peak hour queuing when a train is present.

## I. Summary

Highway 10 throughout the City of Ramsey carries 35,500 vehicles on the west end and 55,000 vehicles on the east end. There are improvement projects planned on either side of this segment. To the west TH 169 is to be converted to a freeway and Highway 10 to the east is also to be converted to a freeway. In Anoka the existing signals at the intersections of Thurston Avenue and Fairoak Avenue are planned to be removed with both locations grade separated which would make Sunfish Lake Blvd the first signal westbound traffic would come to along Highway 10. Without improvements the congestion in Ramsey will worsen and the number of crashes is expected to increase.

## **Access Spacing**

## Intersection to Intersection

All intersections along the corridor were analyzed to determine if the recommended spacing was met as specified in the MnDOT Access Management Manual. The intersection of TH 10 at Jarvis St and Alpine Dr do not meet recommended spacing for primary intersections.

- The following secondary intersections do not meet recommended spacing
  - o Jarvis St to Adams St
  - Adams St to Alpine Dr
  - Alpine Drive to 153<sup>rd</sup> Ave
  - o Beatty St to Bowers Dr
  - o Bowers Dr to Field Access
  - Feldspar St to Dolomite St (eastbound)
  - Dolomite St to McKinley St (eastbound)
  - o McKinley St to Sunfish Lake Blvd
  - Sunfish Lake Blvd to Tungsten St (eastbound)
  - o Tungsten St to Business Access (near East City Limits) (eastbound)
  - Business Access (between Tungsten St & East City Limits) to Sunfish Lake Blvd (westbound)
  - o McKinley St to Feldspar St (westbound)

The access spacing analysis shows that most of the intersections along Highway 10 are spaced too close to one another.

## Intersection to Driveway

All intersections were also analyzed to determine if the recommended spacing to the nearest driveways are met as specified in the MnDOT Access Management Manual. The analysis shows that there are issues at nearly all of the intersections along Highway 10.

- The following intersections do not meet recommended spacing
  - o Jarvis St
  - o Adams St

- o Alpine Dr
- o 153<sup>rd</sup> Ave
- o Beatty St
- o Bowers Dr
- Field Access
- o Ramsey Blvd
- o Feldspar St
- o McKinley St
- Sunfish Lake Blvd
- o Tungsten St
- o Business Access (between Tungsten St & East City Limits)

## Safety Analysis

A five-year (2013-2017) crash analysis was completed at intersections throughout the study area. The intersections of Armstrong Blvd at Alpine Dr and TH 10 at Sunfish Lake Blvd were found to have critical indices greater than one which indicates that the intersections are experiencing more crashes than normal when compared to similar intersections statewide.

There were five fatal crashes reported in the project area in the last 10 years (2008-2017). Two of the crashes were vehicular and three were pedestrian crashes.

## **Operational Analysis**

The operational analysis completed indicates that today all intersections operate well overall, but some movements have excessive delay during the peak hours. If nothing is done the intersections of Sunfish Lake Blvd at McKinley St and TH 10 at Sunfish Lake Blvd are anticipated to operate with LOS F in 2025. By 2045 the following intersection are anticipated to operate with failing LOS:

- TH 10 at Jarvis St
- TH 10 at Alpine Dr
- Armstrong Blvd at Alpine Dr
- EB TH 10 Ramps at Armstrong Blvd
- TH 10 at Ramsey Blvd
- Sunfish Lake Blvd at McKinley St
- TH 10 at Sunfish Lake Blvd
- Sunfish Lake Blvd at Riverdale Dr

Additionally, queuing is anticipated to be problematic in the future with many queues extending multiple miles.

## **Speed and Congestion**

Travel time runs were completed along Highway 10 during the peak hours to ensure the traffic modeling accurately reflected real life.

## **Freight and Transit**

The BNSF railroad runs parallel to Highway 10 throughout the City of Ramsey. This segment of railroad is the busiest statewide with between 58 and 80 freight trains passing through every day. In addition to

freight the Northstar runs 12 commuter trains and the Amtrak runs two trains per day. The traffic model included the trains so that operations would be accurate operations with the train present could be quantified. During the PM peak hour, the queues along Ramsey Blvd and Sunfish Lake Blvd were found to queue onto Highway 10.

# Appendix A





## Figure 1. Access Planning Study

August 2018

**BOLTON** & MENK



































November 2018















rning Movement Counts August 2018







Figure 5. Existing Traffic Operations (West) August 2018







Figure 6. Existing Traffic Operations (East)

August 2018













Figure 8. 2025 Turning Movement Counts August 2018







Figure 9. 2045 Turning Movement Counts August 2018







Figure 10. 2025 Traffic Operations (West) August 2018

![](_page_42_Picture_5.jpeg)

![](_page_43_Picture_0.jpeg)

![](_page_43_Figure_3.jpeg)

Figure 11. 2025 Traffic Operations (East) August 2018

![](_page_43_Picture_5.jpeg)

Real People. Real Solutions.

one of a low work that had been 1.4.6 Bunker Lake Blvd NW 1,950 3,800

![](_page_44_Picture_0.jpeg)

![](_page_44_Figure_3.jpeg)

![](_page_44_Picture_5.jpeg)

![](_page_45_Picture_0.jpeg)

![](_page_45_Figure_3.jpeg)

Figure 13. 2045 Traffic Operations (West) August 2018

![](_page_45_Picture_5.jpeg)

![](_page_46_Picture_0.jpeg)

![](_page_46_Figure_3.jpeg)

Figure 14. 2045 Traffic Operations (East)

August 2018

![](_page_46_Picture_5.jpeg)

![](_page_47_Picture_0.jpeg)

![](_page_47_Figure_3.jpeg)

![](_page_47_Picture_5.jpeg)

# **Appendix B**

Intersection: TH 10 at Jarvis St

## Crash Data, 2013-2017.

![](_page_49_Picture_3.jpeg)

Crashes by Crash Severity				
Fatal	0			
Incapacitating Injury	0			
Non-incapacitating Injury	0			
Possible Injury	0			
Property Damage	4			
Total Crashes	4			

Intersection Characteristics					
Entering Volume	38,845				
Traffic Control	Thru / stop				
Environment	Suburban				
Speed Limit	60 mph				

Annual crash cost = \$6,080

## **Statewide Comparison**

# Total Crash RateObserved0.06Statewide Average0.18Critical Rate0.32Critical Index0.19

Urban Thru / Stop

Fatal & Serious Injury Crash Rate					
Observed	0.00				
Statewide Average	0.33				
Critical Rate	1.90				
Critical Index	0.00				

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.06 per MEV; this is 81% below the critical rate. Based on similar statewide intersections, an additional 19 crashes over the five years would indicate this intersection operaters outside the normal range.

Intersection: TH 10 at Alpine St

## Crash Data, 2013-2017.

![](_page_50_Picture_3.jpeg)

Crashes by Crash Severity				
Fatal	0			
Incapacitating Injury	1			
Non-incapacitating Injury	0			
Possible Injury	2			
Property Damage	8			
Total Crashes	11			

Intersection Characteristics					
Entering Volume	38,035				
Traffic Control	Thru / stop				
Environment	Suburban				
Speed Limit	60 mph				

Annual crash cost = \$159,360

## **Statewide Comparison**

Total Crash Rate					
Observed	0.16				
Statewide Average	0.18				
Critical Rate	0.32				
Critical Index 0.50					

Urban Thru / Stop

Fatal & Serious Injury Crash Rate	
Observed	1.44
Statewide Average	0.33
Critical Rate	1.92
Critical Index	0.75

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.16 per MEV; this is 50% below the critical rate. Based on similar statewide intersections, an additional 12 crashes over the five years would indicate this intersection operaters outside the normal range.

Intersection: TH 10 at Ramsey Blvd

## Crash Data, 2013-2017.

![](_page_51_Picture_3.jpeg)

Crashes by Crash Severity		
Fatal	0	
Incapacitating Injury	1	
Non-incapacitating Injury	4	
Possible Injury	11	
Property Damage	35	
Total Crashes	51	

Intersection Characteristics		
Entering Volume	48,083	
Traffic Control	Signals	
Environment	Suburban	
Speed Limit	60 mph	

Annual crash cost = \$485,800

## Statewide Comparison

Total Crash Rate		
Observed	0.58	
Statewide Average	0.45	
Critical Rate	0.64	
Critical Index	0.91	

Signals: high volume, high speed

Fatal & Serious Injury Crash Rate	
Observed	1.14
Statewide Average	0.48
Critical Rate	1.99
Critical Index	0.57

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.58 per MEV; this is 9% below the critical rate. Based on similar statewide intersections, an additional 6 crashes over the five years would indicate this intersection operaters outside the normal range.

Intersection: TH 10 and Sunfish Lake Blvd

## Crash Data, 2013-2017.

![](_page_52_Picture_3.jpeg)

Crashes by Crash Severity		
Fatal	0	
Incapacitating Injury	1	
Non-incapacitating Injury	7	
Possible Injury	18	
Property Damage	63	
Total Crashes	89	

Intersection Characteristics		
Entering Volume	55,005	
Traffic Control	Signals	
Environment	Suburban	
Speed Limit	60 mph	

Annual crash cost = \$746,560

## **Statewide Comparison**

Total Crash Rate		
Observed	0.89	
Statewide Average	0.45	
Critical Rate	0.63	
Critical Index	1.41	

Signals: high volume, high speed

Fatal & Serious Injury Crash Rate	
Observed	1.00
Statewide Average	0.48
Critical Rate	1.86
Critical Index	0.54

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.89 per MEV; this is 1.4 times the critical rate. If crashes were reduced by 25 over five years, this intersection would perform within normal range.

Intersection: Armstrong Blvd at Alpine St

## Crash Data, 2013-2017.

![](_page_53_Picture_3.jpeg)

Crashes by Crash Severity		
Fatal	0	
Incapacitating Injury	1	
Non-incapacitating Injury	4	
Possible Injury	3	
Property Damage	7	
Total Crashes	15	

Intersection Characteristics		
Entering Volume	7,889	
Traffic Control	Thru / stop	
Environment	Suburban	
Speed Limit	55 mph	

Annual crash cost = \$310,440

## **Statewide Comparison**

Total Crash Rate		
Observed	1.04	
Statewide Average	0.18	
Critical Rate	0.51	
Critical Index	2.04	

Urban Thru / Stop

Fatal & Serious Injury Crash Rate	
Observed	6.94
Statewide Average	0.33
Critical Rate	5.73
Critical Index	1.21

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 1.04 per MEV; this is 2.0 times the critical rate. If crashes were reduced by 7 over five years, this intersection would perform within normal range.

The observed fatal and serious injury crash rate for this period is 6.94 per 100 MEV; this is 1.2 times the critical rate.

Intersection: Armstrong Blvd at Bunker Lake Blvd

## Crash Data, 2013-2017.

![](_page_54_Picture_3.jpeg)

Crashes by Crash Severity		
Fatal	0	
Incapacitating Injury	0	
Non-incapacitating Injury	0	
Possible Injury	0	
Property Damage	1	
Total Crashes	1	

Intersection Characteristics		
Entering Volume	8,322	
Traffic Control	Signals	
Environment	Suburban	
Speed Limit	55 mph	

Annual crash cost = \$1,520

## **Statewide Comparison**

Total Crash RateObserved0.07Statewide Average0.40Critical Rate0.85Critical Index0.08

Signals: low volume, high speed

Fatal & Serious Injury Crash Rate	
Observed	0.00
Statewide Average	0.32
Critical Rate	5.48
Critical Index	0.00

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.07 per MEV; this is 92% below the critical rate. Based on similar statewide intersections, an additional 12 crashes over the five years would indicate this intersection operaters outside the normal range.

Intersection: Armstrong Blvd at 147th St

## Crash Data, 2013-2017.

![](_page_55_Picture_3.jpeg)

Crashes by Crash Severity		
Fatal	0	
Incapacitating Injury	0	
Non-incapacitating Injury	0	
Possible Injury	0	
Property Damage	2	
Total Crashes	2	

Intersection Characteristics		
Entering Volume	10,097	
Traffic Control	Signals	
Environment	Suburban	
Speed Limit	55 mph	

Annual crash cost = \$3,040

## **Statewide Comparison**

Total Crash RateObserved0.11Statewide Average0.40Critical Rate0.80Critical Index0.14

Signals: low volume, high speed

Fatal & Serious Injury Crash Rate	
Observed	0.00
Statewide Average	0.32
Critical Rate	4.73
Critical Index	0.00

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.11 per MEV; this is 86% below the critical rate. Based on similar statewide intersections, an additional 13 crashes over the five years would indicate this intersection operaters outside the normal range.

Intersection: Ramsey Blvd at Bunker Lake Blvd

## Crash Data, 2013-2017.

![](_page_56_Picture_3.jpeg)

Crashes by Crash Severity		
Fatal	0	
Incapacitating Injury	0	
Non-incapacitating Injury	2	
Possible Injury	4	
Property Damage	4	
Total Crashes	10	

Intersection Characteristics		
Entering Volume	11,560	
Traffic Control	Signals	
Environment	Suburban	
Speed Limit	45 mph	

Annual crash cost = \$140,480

## Statewide Comparison

Total Crash Rate		
Observed	0.47	
Statewide Average	0.52	
Critical Rate	0.94	
Critical Index	0.50	

Signals: low volume, low speed

Fatal & Serious Injury Crash Rate	
Observed	0.00
Statewide Average	0.42
Critical Rate	4.61
Critical Index	0.00

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.47 per MEV; this is 50% below the critical rate. Based on similar statewide intersections, an additional 10 crashes over the five years would indicate this intersection operaters outside the normal range.

Intersection: Ramsey Blvd at Sunwood Dr

## Crash Data, 2013-2017.

![](_page_57_Picture_3.jpeg)

Crashes by Crash Severity		
Fatal	0	
Incapacitating Injury	0	
Non-incapacitating Injury	1	
Possible Injury	0	
Property Damage	5	
Total Crashes	6	

Intersection Characteristics		
Entering Volume	14,141	
Traffic Control	Signals	
Environment	Suburban	
Speed Limit	45 mph	

Annual crash cost = \$41,600

## **Statewide Comparison**

Total Crash Rate		
Observed	0.23	
Statewide Average	0.52	
Critical Rate	0.90	
Critical Index	0.26	

Signals: low volume, low speed

Fatal & Serious Injury Crash Rate	
Observed	0.00
Statewide Average	0.42
Critical Rate	4.00
Critical Index	0.00

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.23 per MEV; this is 74% below the critical rate. Based on similar statewide intersections, an additional 18 crashes over the five years would indicate this intersection operaters outside the normal range.

Intersection: Sunfish Lake Blvd at Bunker Lake Blvd

## Crash Data, 2013-2017.

![](_page_58_Picture_3.jpeg)

Crashes by Crash Severity	
Fatal	0
Incapacitating Injury	0
Non-incapacitating Injury	2
Possible Injury	4
Property Damage	10
Total Crashes	16

Intersection Characteristics		
Entering Volume	19,501	
Traffic Control	Signals	
Environment	Suburban	
Speed Limit	45 mph	

Annual crash cost = \$149,600

## Statewide Comparison

Total Crash Rate		
Observed	0.45	
Statewide Average	0.52	
Critical Rate	0.84	
Critical Index	0.54	

Signals: low volume, low speed

Fatal & Serious Injury Crash Rate	
Observed	0.00
Statewide Average	0.42
Critical Rate	3.23
Critical Index	0.00

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.45 per MEV; this is 46% below the critical rate. Based on similar statewide intersections, an additional 14 crashes over the five years would indicate this intersection operaters outside the normal range.

Intersection: Sunfish Lake Blvd at McKinley St

## Crash Data, 2013-2017.

![](_page_59_Picture_3.jpeg)

Crashes by Crash Severity		
Fatal	0	
Incapacitating Injury	0	
Non-incapacitating Injury	2	
Possible Injury	0	
Property Damage	4	
Total Crashes	6	

Intersection Characteristics		
Entering Volume	11,506	
Traffic Control	Thru / stop	
Environment	Suburban	
Speed Limit	45 mph	

Annual crash cost = \$74,080

## Statewide Comparison

# Total Crash RateObserved0.29Statewide Average0.18Critical Rate0.45Critical Index0.64

Urban Thru / Stop

Fatal & Serious Injury Crash Rate	
Observed	0.00
Statewide Average	0.33
Critical Rate	4.30
Critical Index	0.00

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.29 per MEV; this is 36% below the critical rate. Based on similar statewide intersections, an additional 4 crashes over the five years would indicate this intersection operaters outside the normal range.

Intersection: Sunfish Lake Blvd at Riverdale Dr

## Crash Data, 2013-2017.

![](_page_60_Picture_3.jpeg)

Crashes by Crash Severity		
Fatal	0	
Incapacitating Injury	0	
Non-incapacitating Injury	0	
Possible Injury	1	
Property Damage	0	
Total Crashes	1	

Intersection Characteristics		
313		
/ stop		
ırban		
nph		

Annual crash cost = \$16,600

## Statewide Comparison

# Total Crash RateObserved0.42Statewide Average0.18Critical Rate1.10Critical Index0.38

Urban Thru / Stop

Fatal & Serious Injury	Crash Rate
Observed	0.00
Statewide Average	0.33
Critical Rate	25.91
Critical Index	0.00

The observed crash rate is the number of crashes per million entering vehicles (MEV). The critical rate is a statistical comparison based on similar intersections statewide. An observed crash rate greater than the critical rate indicates that the intersection operates outside the expected, normal range. The critical index reports the magnitude of this difference.

The observed total crash rate for this period is 0.42 per MEV; this is 62% below the critical rate. Based on similar statewide intersections, an additional 2 crashes over the five years would indicate this intersection operaters outside the normal range.

# **Trunk Highway Section Summary**

Section: TH 10 from Jarvis St to Armstrong Blvd

Crash Data, 2013-2017. Includes crashes at junctions.

Crashes by Crash Seve	erity	Section Characteristics
Fatal	0	Length 2.300 miles
Incapacitating Injury	3	Volume (ADT) 35,500
Non-incapacitating Injury	6	Environment Rural
Possible Injury	13	Median Type Divided / depressed
Property Damage	37	Number of Lanes 4
Total Crashes	59	Roadway Design Expressway
Statewide Comparison	,	Rural Expressway
Total Crash Rate		Fatal & Serious Injury Crash Rate
Observed	0.40	Observed 2.01
Statewide Average	0.66	Statewide Average 1.60
Critical Rate	0.83	Critical Rate 3.26
Critical Index	0.48	Critical Index 0.62

### **Trunk Highway Section Summary** Section: TH 10 from Armstrong Blvd to East City Limits Crash Data, 2011-2015. Includes crashes at junctions. **Crashes by Crash Severity Section Characteristics** 2.800 miles Fatal 0 Length Volume (ADT) Incapacitating Injury 47,400 3 Non-incapacitating Injury Environment Suburban 17 Possible Injury Median Type Divided / depressed 43 Number of Lanes Property Damage 4 155 **Total Crashes** 218 Roadway Design Expressway Annual crash cost per mile = \$667,643 **Statewide Comparison** Urban Expressway **Total Crash Rate** Fatal & Serious Injury Crash Rate Observed 0.90 Observed 1.24 Statewide Average Statewide Average 1.64 2.02 Critical Rate Critical Rate 3.40 1.85 **Critical Index Critical Index** 0.36 0.49

# Appendix C

Table A1. Existing (2018) Alvi Peak Hour	Table	A1.	Existing	(2018)	AM	Peak	Hour
--	-------	-----	----------	--------	----	------	------

Table A1. Existing (2018) AM Peak Hour 7:00-8:00am																												Traffic	g (feet)				
			Demand	d volume	es		Modele	d Volume	es		Мо	del - Der	mand			To Move	otal Delay ement (se	/ by c/veh)	Leve	el of Service by Movement	LC Apr	)S by proach	L	os		Left Turr	n	Thr	ough Qu	eue	I	Right Turn	1
Location	Aprch	L	т	R	Total	L	т	R	total	L	т	R	Total	%	GEH	L	т	R	L	TR	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St Stop Controlled	EB WB NB SB	23 4 18 7	1892 1282 4 1	13 11 1 18	1928 1297 23 26	22 1 18 18	1879 1287 4 1	12 12 2 7	1913 1300 24 26	-1 -3 0 11	-13 5 0 0	-1 1 1 -11	-15 3 1 0	-1% 0% 4% 0%	0 0 0	25 14 124 86	1 1 128 157	2 2 115 28	D B F F	AAAAFFFD	1 1 124 73	A A F F	3	A	250 300	25 25 25 25	75 25 125 100		0 25 25 25	0 75 125 100	225 250	0 0 25 25	0 0 125 100
TH 10 at Alpine Dr Stop Controlled	EB WB SB	40 30	1898 1243	9 54	1938 1252 84	40 30	1869 1245	8 54	1909 1253 84	0 0 0	-29 2 0	0 -1 0	-29 1 0	-1% 0% 0%	1 0 0	10 25	1 3	3 12	A A D	A A A A A B	1 3 17	A A C	2	A	375 225	25 25	100 100		25 25	50 25	275 225	0 25	0 100
Armstrong Blvd at Alpine Dr Stop Controlled	EB WB NB SB	5 9 14 2	18 29 72 351	95 1 2 13	118 39 88 366	5 30 14 2	18 7 63 352	88 1 1 11	111 38 78 365	0 21 0 0	0 -22 -9 1	-7 0 -1 -2	-7 -1 -10 -1	-6% -3% <mark>-11%</mark> 0%	1 0 1 0	21 28 5 1	16 16 2 0	18 11 3 0	C D A A	C C C B A A A A	18 3 26 0	C A D A	5	A		25 25 25 25	100 75 50 25		25 25 0 0	125 75 0 0	275 250	25 25 0 0	150 75 0 0
Armstrong Blvd at Bunker Lake Blvd Signalized Intersection	EB WB NB SB	0 47 9 214	8 3 57 269	0 31 117 1	8 81 183 484	0 45 12 199	8 3 48 273	0 31 105 1	8 79 165 473	0 -2 3 -15	0 0 -9 4	0 0 -12 0	0 -2 -18 -11	0% -2% -10% -2%	0 0 1 1	0 35 34 29	41 24 12 1	0 7 7 0	A D C C	DACABAAA	41 24 11 13	D C B B	14	В	300 225 325 300	0 25 25 50	0 75 75 275		25 25 25 0	50 25 75 0	300 300 285 300	0 25 25 0	0 50 100 0
147th St at Armstrong Blvd Signalized Intersection	EB WB NB SB	0 76 0 54	2 0 139 325	3 14 150 2	5 90 289 381	0 75 0 42	3 0 153 276	2 14 173 2	5 89 326 320	0 -1 0 -12	1 0 14 -49	-1 0 23 0	0 -1 37 -61	0% -1% 13% -16%	0 0 2 3	0 17 0 19	29 0 7 5	6 17 4 3	A B A B	CAABAAAA	20 17 5 7	C B A A	7	А	200 275 300 350	0 25 0 25	0 75 0 100		25 0 25 25	50 0 75 100	200 275 300 175	25 25 25 25	25 50 75 25
WB TH 10 Ramps at Armstrong Blvd Signalized Intersection	WB NB SB	0 14	239 246	66 157	66 253 403	0 14	259 209	67 144	67 273 353	0 0 0	0 20 -37	1 0 -13	1 20 -50	2% 8% -12%	0 1 3	0 19	1 9	9 4	A B A	A A A A A A	9 2 7	A A A	1	A	600 350	0 25	0 50		0 25 25	0 75 75	600 250	25 25	75 75
EB TH 10 Ramps at Armstrong Blvd Stop Controlled	EB WB NB SB	207 4 7 46	11 10 16 7	5 58 2 193	223 72 25 246	201 3 7 40	11 10 16 5	4 57 2 163	216 70 25 208	-6 -1 0 -6	0 0 0 -2	-1 -1 0 -30	-7 -2 0 -38	-3% -3% 0% -15%	0 0 0 3	16 10 4 1	14 10 0 1	12 6 1 2	C A A A	B B B A A A A A	0 2 0 17	A A A C	3	A	225 200 275	25 25 25 0	150 50 25 0		25 25 0 0	50 50 0 0	225 225 275	25 0 0 0	50 0 0 0
Bunker Lake Blvd at Ramsey Blvd Signalized Intersection	EB WB NB SB	15 18 20 101	247 76 68 301	6 22 12 39	268 116 100 441	12 21 31 98	246 74 102 297	6 20 17 45	264 115 150 440	-3 3 11 -3	-1 -2 34 -4	0 -2 5 6	-4 -1 50 -1	-1% -1% 50% 0%	0 0 4 0	36 35 35 30	22 21 21 15	7 5 5 6	D C C C	C A C A C A B A	23 21 22 18	C C C B	20	с	285 285 785 285	25 25 25 25	75 75 100 150		25 25 25 25	150 75 100 150	285 285 285 285	25 25 25 25	50 50 50 50
Sunwood Dr at Ramsey Blvd Signalized Intersection	EB WB NB SB	29 23 132 62	124 127 118 246	98 22 60 112	251 172 310 420	23 24 117 65	123 120 105 260	103 23 52 122	249 167 274 447	-6 1 -15 3	-1 -7 -13 14	5 1 -8 10	-2 -5 -36 27	-1% -3% -12% 6%	0 0 2 1	37 35 40 33	24 25 20 19	6 27 11 7	D C D C	C A C C C B B A	18 27 27 18	B C C B	21	С	350 225 700 300	25 25 25 25	100 75 250 150		25 25 25 25	175 225 100 150	250 300 300	25 25 25 25 25	75 225 75 125
TH 10 at Ramsey Blvd Signalized Intersection	EB WB NB SB	64 14 25 320	1822 811 47 22	76 267 52 37	1962 1092 124 379	64 13 23 314	1823 760 48 21	75 259 52 40	1962 1032 123 375	0 -1 -2 -6	1 -51 1 -1	-1 -8 0 3	0 -60 -1 -4	0% -5% -1% -1%	0 2 0 0	102 59 79 107	17 10 105 391	6 7 24 13	F E E F	BABAFCFB	19 10 66 113	B B E F	28	С	575 775 300 1000	50 25 25 25	200 75 75 275		125 25 50 25	875 175 150 75	400 275 225 125	25 25 25 25	50 100 125 75
Bunker Lake Blvd at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	15 92 131 104	418 227 126 302	94 30 75 19	527 349 332 425	11 84 126 105	417 215 104 286	92 30 75 17	520 329 305 408	-4 -8 -5 1	-1 -12 -22 -16	-2 0 0 -2	-7 -20 -27 -17	-1% -6% -8% -4%	0 1 2 1	37 30 37 31	43 22 26 25	7 4 6 5	D C D C	D A C A C A C A	36 23 23 26	D C C C	29	С	450 400 425 400	25 25 50 25	75 150 225 200		75 25 25 50	400 175 100 175	300 300 325 350	25 25 25 25	100 50 100 50
McKinley St. at Sunfish Lake Blvd Stop Controlled	EB WB NB SB	0 35 57 29	0 2 331 405	19 12 114 0	19 49 502 434	0 36 47 30	0 2 294 431	19 11 107 0	19 49 448 461	0 1 -10 1	0 0 -37 26	0 -1 -7 0	0 0 -54 27	0% 0% -11% 6%	0 0 2 1	0 25 6 7	0 20 3 0	8 12 1 0	A C A A	AACBAAAA	8 22 3 1	A C A A	3	A	125 325	25 25 25 25	50 100 75 75	75	25 25 25 25	50 100 50 25	175 325	25 25 0 25	75 125 0 25
TH 10 at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	91 7 8 404	2048 1052 29 8	4 348 65 87	2143 1407 102 499	93 6 8 391	2119 965 26 8	5 330 57 87	2217 1301 91 486	2 -1 0 -13	71 -87 -3 0	1 -18 -8 0	74 -106 -11 -13	3% -8% -11% -3%	2 3 1 1	75 125 111 91	12 33 105 101	6 9 42 15	E F F	BACAFDFB	14 28 66 78	B C E E	27	С	750 700 150 675	50 25 25 125	250 75 75 400		75 125 25 25	525 725 125 125	250 675 175 225	25 25 25 25	25 125 100 125
Riverdale Dr at Sunfish Lake Blvd Stop Controlled	EB WB SB	85 14	9 0	5 27	94 5 41	85 7	10 0	5 13	95 5 20	0 0 -7	1 0 0	0 0 -14	1 0 -21	1% 0% -51%	0 0 4	0 10	0 0	0 9	A A A	A A A A A A	0 0 9	A A A	2	А		0 25	0 75		0 0	0 0		0 25	0 75

Table A2. LABLING (2010) FIVE FEAK HOUL	Table A2	. Existing	(2018)	PM Peak Hour	
---	----------	------------	--------	--------------	--

Table A2. Existing (2018) PM Peak Hour 4:15-5:15pm																									ſ				Traffic	Queuing	(feet)			
Looption	Avanah		Demand	volume	s		Modeled	Volume	s		Мо	del - Den	nand		CELL	To Move	otal Delay ement (se	v by c/veh)	Leve	l of Servic Novement	e by	LOS Appro	by bach	LO	S	l	Left Turn		Thr	ough Que	eue	R	ight Turn	
Location	Aprcn	L	т	R	Total	L	т	R	Total	L	т	R	Total	%	GEH	L	т	R	L	т	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St Stop Controlled	EB WB NB SB	21 3 17 23	1599 1947 1 1	11 21 7 21	1631 1971 25 45	22 7 18 21	1588 1835 1 1	9 9 7 22	1619 1851 26 44	1 4 1 -2	-11 -112 0 0	-2 -12 0 1	-12 -120 1 -1	-1% -6% 4% -2%	0 3 0 0	49 11 95 112	1 1 116 127	1 1 30 30	E B F F	A A F F	A A D D	1 2 78 71	A A F F	3	А	250 300	25 25 25 25	75 75 100 150		25 25 25 25	25 100 100 150	225 250	25 25 25 25	25 25 125 150
TH 10 at Alpine Dr Stop Controlled	EB WB SB	125 29	1705 2015	42 61	1830 2057 90	127 28	1704 1916	39 61	1831 1955 89	2 0 -1	-1 -99 0	0 -3 0	1 -102 -1	0% -5% -1%	0 2 0	28 63	1 5	6 15	D A F	A A A	A A C	3 5 30	A A D	5	A	375 225	50 0 25	175 0 125		25 25 0	75 175 0	275 225	0 25 25	0 25 100
Armstrong Blvd at Alpine Dr Stop Controlled	EB WB NB SB	10 14 75 6	36 18 433 142	42 13 29 8	88 45 537 156	9 21 74 7	37 14 447 138	42 11 29 11	88 46 550 156	-1 7 -1 1	1 -4 14 -4	0 -2 0 3	0 1 13 0	0% 2% 2% 0%	0 0 1 0	20 30 11 2	17 18 12 0	13 17 8 0	C D B A	C C B A	B C A A	15 11 23 0	C B C A	10	В		25 25 25 25	100 75 150 25		25 25 0 0	125 75 0 0	275 250	25 25 0 0	150 75 0 0
Armstrong Blvd at Bunker Lake Blvd Signalized Intersection	EB WB NB SB	1 101 5 45	1 2 339 149	8 209 64 2	10 312 408 196	1 102 5 46	1 2 350 157	8 206 68 2	10 310 423 205	0 1 0 1	0 0 11 8	0 -3 4 0	0 -2 15 9	0% -1% 4% 5%	0 0 1 1	31 29 40 35	20 23 12 1	1 8 7 2	C C D C	C C B A	A A A A	6 15 11 9	A B B A	12	В	300 225 325 300	25 25 25 25	25 100 50 100		25 25 25 0	25 50 150 0	300 300 285 300	0 25 25 0	0 100 75 0
147th St at Armstrong Blvd Signalized Intersection	EB WB NB SB	1 139 2 63	0 0 322 207	2 108 151 0	3 247 475 270	1 139 3 59	0 0 317 207	3 106 153 0	4 245 473 266	0 0 1 -4	0 0 -5 0	1 -2 2 0	1 -2 -2 -4	33% -1% 0% -1%	1 0 0 0	26 19 18 24	0 0 11 7	8 19 5 3	C B B C	A A B A	A B A A	12 19 9 10	B B A B	12	В	200 275 300 350	25 25 25 25	25 100 25 100		0 0 25 25	0 0 100 100	200 275 300 175	25 25 25 0	50 150 75 0
WB TH 10 Ramps at Armstrong Blvd Signalized Intersection	WB NB SB	38 31	251 156	253 206	291 282 362	38 21	234 148	239 203	277 255 351	0 -10 0	0 -17 -8	-14 0 -3	-14 -27 -11	-5% -10% -3%	1 2 1	43 21	3 32	11 24	D C A	A A C	B A C	15 4 28	B A C	16	В	600 350	25 25 0	125 50 0		0 25 25	0 75 75	600 250	25 0 25	75 0 150
EB TH 10 Ramps at Armstrong Blvd Stop Controlled	EB WB NB SB	207 4 7 31	11 10 16 5	5 58 2 130	223 72 25 166	187 3 7 36	12 10 16 6	3 57 2 145	202 70 25 187	-20 -1 0 5	1 0 0 1	-2 -1 0 15	-21 -2 0 21	-9% -3% 0% 13%	1 0 0 2	14 9 4 1	14 10 0 2	7 6 1 2	B A A A	B A A A	A A A A	0 2 0 13	A A A B	7	A	225 200 275	25 25 25 0	150 50 25 0		25 25 0 0	50 50 0 0	225 225 275	25 0 0 0	50 0 0 0
Bunker Lake Blvd at Ramsey Blvd Signalized Intersection	EB WB NB SB	53 21 40 35	97 315 227 124	12 93 27 26	162 429 294 185	52 21 48 30	96 307 286 126	13 100 35 27	161 428 369 183	-1 0 8 -5	-1 -8 59 2	1 7 8 1	-1 -1 75 -2	-1% 0% <mark>26%</mark> -1%	0 0 4 0	33 33 29 35	19 24 19 17	6 6 5 7	C C C C	B C B B	A A A A	23 20 19 19	C B B B	20	В	285 285 785 285	25 25 25 25	100 75 125 100		25 50 25 25	100 175 225 100	285 285 285 285	25 25 25 25	50 75 50 50
Sunwood Dr at Ramsey Blvd Signalized Intersection	EB WB NB SB	81 87 77 11	110 122 219 119	129 29 32 45	320 238 328 175	79 91 100 9	109 121 266 108	131 28 41 44	319 240 407 161	-2 4 23 -2	-1 -1 47 -11	2 -1 9 -1	-1 2 79 -14	0% 1% 24% -8%	0 0 4 1	35 35 45 38	26 25 27 22	5 23 19 5	C C D D	C C C C	A C B A	20 29 31 18	B C C B	25	С	350 225 700 300	25 25 25 25	150 175 225 50		25 25 25 25	175 225 200 75	250 300 300	25 25 25 25	75 225 50 75
TH 10 at Ramsey Blvd Signalized Intersection	EB WB NB SB	40 33 46 252	1145 1810 38 31	61 309 16 106	1246 2152 100 389	41 38 46 215	1148 1927 38 26	57 328 14 91	1246 2293 98 332	1 5 0 -37	3 117 0 -5	-4 19 -2 -15	0 141 -2 -57	0% 7% -2% -15%	0 3 0 3	106 84 95 131	16 14 97 129	6 10 9 59	F F F	B B F F	A B A E	19 14 84 111	B B F F	25	С	575 775 300 1000	25 25 25 25	150 150 100 175		50 50 25 25	450 500 150 225	400 275 225 125	25 25 25 25	50 100 50 225
Bunker Lake Blvd at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	39 112 68 46	231 372 320 177	163 110 84 12	433 594 472 235	36 108 62 49	235 361 281 165	166 111 77 10	437 580 420 224	-3 -4 -6 3	4 -11 -39 -12	3 1 -7 -2	4 -14 -52 -11	1% -2% <mark>-11%</mark> -5%	0 1 2 1	32 29 31 30	39 25 24 22	6 5 5 5	C C C C	D C C C	A A A A	26 22 22 24	C C C C	23	С	450 400 425 400	25 25 25 25	100 200 150 100		50 50 25 25	200 250 250 125	300 300 325 350	25 25 25 25	100 75 100 50
McKinley St at Sunfish Lake Blvd Stop Controlled	EB WB NB SB	17 91 44 4	1 1 342 477	48 56 18 1	66 148 404 482	16 102 41 2	1 1 343 434	49 59 18 1	66 162 402 437	-1 11 -3 -2	0 0 1 -43	1 3 0 0	0 14 -2 -45	0% 9% 0% -9%	0 1 0 2	25 113 11 3	23 20 7 2	14 83 3 1	C F B A	C C A A	B F A A	17 101 7 2	C F A A	20	С	125 325	25 100 25 25	100 575 75 25	75	25 125 25 0	100 600 25 0	175 325	25 125 0 0	100 600 0 0
TH 10 at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	91 36 10 520	1568 2159 12 19	9 297 20 163	1668 2492 42 702	81 24 7 441	1528 2252 12 15	10 311 20 138	1619 2587 39 594	-10 -12 -3 -79	-40 93 0 -4	1 14 0 -25	-49 95 -3 -108	-3% 4% -7% -15%	1 2 0 4	128 122 76 152	15 25 109 132	6 20 24 111	F F E F	B C F F	A C C F	21 25 59 142	C C E F	38	D	750 700 150 675	75 25 25 175	300 125 75 775		75 275 25 25	550 2250 75 300	250 675 175 225	25 125 25 50	25 1425 75 375
Riverdale Dr at Sunfish Lake Blvd Stop Controlled	EB WB SB	30 12	4 3	9 46	34 12 58	30 16	4 4	9 36	34 13 52	0 0 4	0 1 0	0 0 -10	0 1 -6	0% 8% -10%	0 0 1	0	0 0	0 10	A A B	A A A	A A B	0 0 10	A A B	6	A	_	0 0 25	0 0 100		0 0 0	0 0 0	_	0 0 25	0 0 100

Table A3. 2025 No Build AM Peak Hour	Table	A3.	2025	No	Build	AM	Peak	Hour	
--------------------------------------	-------	-----	------	----	-------	----	------	------	--

Table A3. 2025 No Build AM Peak Hour 7:00-8:00am																									[				; (feet)					
			Demand	l volume	25		Modelec	l Volume	s		Mo	del - Der	nand			T Mov	otal Delay ement (se	/ by c/veh)	Leve	el of Servico Movement	e by	LOS Appr	S by roach	LC	DS		Left Turn	1	Thr	ough Qu	eue		Right Turn	1
Location	Aprch	L	т	R	Total	L	т	R	total	L	т	R	Total	%	GEH	L	т	R	L	т	R	Delay	LOS	elay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St Stop Controlled	EB WB NB SB	25 19 56 28	1962 1308 18 4	39 16 5 9	2026 1343 79 41	23 1 33 29	1949 1124 10 5	37 37 2 8	2009 1162 45 42	-2 -18 -23 1	-13 -184 -8 1	-2 21 -3 -1	-17 -181 -34 1	-1% -13% -43% 2%	0 5 4 0	29 71 1417 401	1 1 1550 380	2 2 1602 317	D F F F	A A F F	A A F F	1 3 1455 382	A A F F	26	D	250 300	25 25 700 100	75 50 1025 300		25 25 700 100	100 50 1025 300	225 250	25 25 700 100	100 100 1025 300
TH 10 at Alpine Dr Stop Controlled	EB WB SB	49 53	1950 1266	21 62	1999 1287 115	51 52	1939 1098	17 61	1990 1115 113	2 0 -1	-11 -168 0	0 -4 -1	-9 -172 -2	0% -13% -2%	0 5 0	11 - 29	1 4 -	- 5 12	B - D	A A -	- A B	1 4 20	A A C	3	A	375 225	25 25	100 125		25 25	100 25	275 225	25 25	25 125
Armstrong Blvd at Alpine Dr Stop Controlled	EB WB NB SB	10 20 23 2	31 55 99 432	208 1 6 18	249 76 128 452	10 56 19 2	27 18 81 429	210 1 5 16	247 75 105 447	0 36 -4 0	-4 -37 -18 -3	2 0 -1 -2	-2 -1 -23 -5	-1% -1% <mark>-18%</mark> -1%	0 0 2 0	60 155 7 1	37 72 4 0	41 180 5 0	F F A A	E F A A	E F A A	41 136 4 0	E F A A	24	С		75 75 25 25	375 300 75 25		75 75 0 0	375 300 0 0	275 250	75 75 0 0	400 300 0 0
Armstrong Blvd at Bunker Lake Blvd Signalized Intersection	EB WB NB SB	10 159 13 409	17 12 12 270	31 49 49 2	58 220 74 681	8 150 15 430	16 10 49 272	33 51 122 3	57 211 186 705	-2 -9 2 21	-1 -2 37 2	2 2 73 1	-1 -9 112 24	-2% -4% 151% 4%	0 1 10 1	49 37 47 39	43 33 24 2	1 7 10 5	D D D D	D C C A	A A B A	20 30 17 24	B C B C	24	С	300 225 325 300	25 25 25 125	50 125 50 575		25 25 25 25	75 50 75 75	300 300 285 300	25 25 25 0	50 75 100 0
147th St at Armstrong Blvd Signalized Intersection	EB WB NB SB	13 80 1 64	8 1 193 389	10 21 170 7	31 102 364 460	13 79 1 57	9 1 152 398	8 19 146 7	30 99 299 462	0 -1 0 -7	1 0 -41 9	-2 -2 -24 0	-1 -3 -65 2	-3% -3% -18% 0%	0 0 4 0	25 20 30 19	29 11 9 6	8 18 4 3	C C C B	C B A A	A B A A	22 20 7 8	C B A A	9	A	200 275 300 350	25 25 25 25	50 75 25 100		25 25 25 25	50 25 75 150	200 275 300 175	25 25 25 25	50 50 75 25
WB TH 10 Ramps at Armstrong Blvd Signalized Intersection	WB NB SB	19 26	288 277	76 207	95 314 484	13 20	244 271	54 216	67 264 487	-6 -6 0	0 -44 -6	-22 0 9	-28 -50 3	-29% -16% 1%	3 3 0	42 21 -	- 1 40	8 - 38	D C -	- A D	A - D	14 3 39	B A D	6	A	600 350	25 25	75 50		25 25	75 125	600 250	25 25	50 150
EB TH 10 Ramps at Armstrong Blvd Stop Controlled	EB WB NB SB	266 14 8 43	22 19 21 20	14 27 37 233	302 60 66 296	218 14 10 43	19 17 21 23	11 26 35 218	248 57 66 284	-48 0 2 0	-3 -2 0 3	-3 -1 -2 -15	-54 -3 0 -12	-18% -5% 0% -4%	3 0 0 1	19 12 6 1	17 12 0 2	11 6 1 3	C B A A	C B A A	B A A A	1 2 0 11	A A A B	3	A	225 200 275	25 25 25 0	175 50 50 0		25 25 0 0	50 50 0 0	225 225 275	25 0 0 0	50 0 0 0
Bunker Lake Blvd at Ramsey Blvd Signalized Intersection	EB WB NB SB	17 31 20 110	231 84 74 344	24 24 36 42	272 139 130 496	16 32 32 104	258 81 115 343	23 21 52 46	297 134 199 493	-1 1 12 -6	27 -3 41 -1	-1 -3 16 4	25 -5 69 -3	9% -4% 53% -1%	1 0 5 0	36 37 36 32	24 20 21 17	7 5 6 6	D D D C	C C C B	A A A A	23 22 20 19	C C B B	21	С	285 285 785 285	25 25 25 25 25	75 100 75 150		50 25 25 25	150 75 100 150	285 285 285 285 285	25 25 25 25	50 50 75 50
Sunwood Dr at Ramsey Blvd Signalized Intersection	EB WB NB SB	32 30 149 66	138 135 128 266	130 23 70 120	300 188 347 452	29 30 184 56	136 131 148 227	131 23 90 112	296 184 422 395	-3 0 35 -10	-2 -4 20 -39	1 0 20 -8	-4 -4 75 -57	-1% -2% 22% -13%	0 0 4 3	40 38 43 41	25 25 21 21	5 23 12 6	D D D D	C C C C	A C B A	18 27 29 20	B C C B	23	С	350 225 700 300	25 25 50 25	125 75 425 150		25 25 25 25	150 275 125 150	250 300 300	25 25 25 25	75 275 100 125
TH 10 at Ramsey Blvd Signalized Intersection	EB WB NB SB	77 29 30 384	2076 939 50 25	82 328 65 44	2235 1296 145 453	61 32 26 310	1855 897 51 20	71 322 66 37	1987 1251 143 367	-16 3 -4 -74	-221 -42 1 -5	-11 -6 1 -7	-248 -45 -2 -86	-11% -3% -1% -19%	5 1 0 4	104 79 81 133	21 14 105 480	8 8 20 41	F E F F	C B F F	A A C D	23 14 61 143	C B E F	33	С	575 775 300 1000	50 25 25 25	200 150 75 275		150 50 50 25	1050 325 175 75	400 275 225 125	25 25 25 25	50 125 125 75
Bunker Lake Blvd at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	16 95 149 107	453 246 130 312	105 32 80 20	574 373 359 439	12 93 147 111	452 240 114 309	106 34 82 19	570 367 343 439	-4 -2 -2 4	-1 -6 -16 -3	1 2 2 -1	-4 -6 -16 0	-1% -2% -4% 0%	0 0 1 0	40 32 39 31	43 23 25 26	7 5 6 5	D C D C	D C C C	A A A A	36 24 24 26	D C C C	29	С	450 400 425 400	25 25 50 25	75 175 250 200		75 25 25 50	450 175 100 175	300 300 325 350	25 25 25 25	100 50 100 50
McKinley St. at Sunfish Lake Blvd Stop Controlled	EB WB NB SB	0 36 63 35	0 3 345 432	28 12 119 0	28 51 527 467	0 34 59 36	0 5 328 470	26 13 125 0	26 52 512 506	0 -2 -4 1	0 2 -17 38	-2 1 6 0	-2 1 -15 39	-7% 2% -3% 8%	0 0 1 2	0 27 6 10	0 20 3 0	9 19 2 0	A D A B	A C A A	A C A A	9 25 3 1	A C A A	3	A	125 325	25 25 25 25	50 100 100 75	75	25 25 25 25	50 100 25 50	175 325	25 25 25 25	75 125 50 50
TH 10 at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	101 21 20 478	2313 1175 36 10	24 390 92 106	2438 1586 148 594	91 20 17 425	2157 1199 35 9	19 385 95 94	2267 1604 147 528	-10 -1 -3 -53	-156 24 -1 -1	-5 -5 3 -12	-171 18 -1 -66	-7% 1% -1% -11%	4 0 0 3	73 89 84 115	14 32 110 111	7 9 56 47	E F F	B C F F	A A E D	17 27 72 103	B C E F	32	С	750 700 150 675	50 25 25 150	275 125 125 450		100 150 25 25	825 850 150 150	250 675 175 225	25 25 50 25	50 125 225 150
Riverdale Dr at Sunfish Lake Blvd Stop Controlled	EB WB SB	142 15	10 0	6 40	152 6 55	142 15	8 0	5 33	150 5 48	0 0 0	-2 0 0	0 -1 -7	-2 -1 -7	-1% -17% -13%	0 0 1	0 - 10	0 0 -	- 0 10	A - B	A A -	- A B	0 0 10	A A B	2	А		0 25	0 75		0 0	0 0		0 25	0 75

Table A4.	2025 N	o Build	PM P	eak Hour

Table A4. 2025 No Build PM Peak Hour 4:15-5:15pm																									[				Traffic	Queuing	(feet)			
Location	Amuch		Demand	l volume	S		Modeled	l Volume	s		Мо	del - Den	nand		CELL	To Move	tal Delay ment (se	by c/veh)	Leve	l of Service Novement	by	LOS Appro	by bach	LC	)S	l	Left Turn		Thi	ough Que	eue	R	ight Turn	i
Location	Aprcn	L	т	R	Total	L	т	R	total	L	т	R	Total	%	GEH	L	т	R	L	т	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St Stop Controlled	EB WB NB SB	25 13 53 25	1743 2020 5 5	34 35 30 38	1802 2068 88 68	23 8 32 6	1729 2052 5 1	33 33 22 8	1785 2093 59 15	-2 -5 -21 -19	-14 32 0 -4	-1 -2 -8 -30	-17 25 -29 -53	-1% 1% -33% -78%	0 1 3 8	74 30 1347 179	1 2 613 299	2 2 610 81	F D F F	A A F F	A A F F	2 3 1010 135	A A F F	17	С	250 300	25 25 650 25	100 100 975 125		25 25 650 25	25 200 975 125	225 250	25 25 675 25	25 25 1000 125
TH 10 at Alpine Dr Stop Controlled	EB WB SB	136 51	1737 2045	77 63	1873 2122 114	129 45	1638 2043	80 62	1767 2123 107	-7 0 -6	-99 -2 0	0 3 -1	-106 1 -7	-6% 0% -6%	2 0 1	42 - 147	1 12 -	- 12 17	<u>Е</u> - F	A B -	- B C	4 12 72	A B F	10	В	375 225	50 50	275 275		25 25	75 175	275 225	25 50	50 250
Armstrong Blvd at Alpine Dr Stop Controlled	EB WB NB SB	74 30 149 9	58 25 456 151	13 15 66 3	145 70 671 163	73 27 92 10	54 30 296 146	15 13 46 5	142 70 434 161	-1 -3 -57 1	-4 5 -160 -5	2 -2 -20 2	-3 0 -237 -2	-2% 0% -35% -1%	0 0 10 0	25 23 10 4	23 16 9 0	19 16 7 0	D C A A	C C A A	C C A A	24 9 19 0	C A C A	11	В		25 25 25 25	175 100 125 75		25 25 0 0	175 100 0 0	275 250	25 25 0 0	200 100 0 0
Armstrong Blvd at Bunker Lake Blvd Signalized Intersection	EB WB NB SB	1 152 10 80	13 152 345 155	11 394 167 15	25 698 522 250	0 49 9 64	3 6 319 113	13 118 159 12	16 173 487 189	-1 -103 -1 -16	-10 -146 -26 -42	2 -276 -8 -3	-9 -525 -35 -61	-36% -75% -7% -24%	2 25 2 4	40 35 33 31	40 32 10 1	1 8 7 1	D D C C	D C A A	A A A A	8 16 9 11	A B A B	11	В	300 225 325 300	25 25 25 25	25 75 50 125		25 25 25 0	25 75 125 0	300 300 285 300	25 25 25 0	25 75 100 0
147th St at Armstrong Blvd Signalized Intersection	EB WB NB SB	5 139 8 72	3 5 398 264	5 108 164 246	13 252 570 582	5 140 7 35	3 4 375 142	5 107 159 3	13 251 541 180	0 1 -1 -37	0 -1 -23 -122	0 -1 -5 -243	0 -1 -29 -402	0% 0% -5% -69%	0 0 1 21	26 17 22 22	24 16 10 7	6 18 5 2	C B C C	C B A A	A B A A	18 18 8 10	B B A B	11	В	200 275 300 350	25 25 25 25	50 100 50 75		25 25 25 25	25 50 150 100	200 275 300 175	25 25 25 25	25 125 75 25
WB TH 10 Ramps at Armstrong Blvd Signalized Intersection	WB NB SB	82 117	312 187	258	340 429 409	76 125	303 126	238 164	314 428 290	-6 8 0	0 -9 -61	-20 0 -58	-26 -1 -119	-8% 0% -29%	1 0 6	41 26 -	- 4 13	11 - 7	D C -	- A B	В - А	18 10 10	B B A	4	A	600 350	25 25	200 150		25 25	150 75	600 250	25 25	100 125
EB TH 10 Ramps at Armstrong Blvd Stop Controlled	EB WB NB SB	228 6 19 44	42 14 119 90	26 82 7 135	296 102 145 269	232 7 20 39	43 11 114 56	26 81 10 108	301 99 144 203	4 1 1 -5	1 -3 -5 -34	0 -1 3 -27	5 -3 -1 -66	2% -3% -1% -25%	0 0 0 4	32 14 4 1	17 11 0 1	10 6 1 1	D B A A	C B A A	B A A A	1 4 0 2	A A A A	3	A	225 200 275	50 25 25 0	300 50 50 0		25 25 0 0	75 50 0 0	225 225 275	25 0 0 0	75 0 0 0
Bunker Lake Blvd at Ramsey Blvd Signalized Intersection	EB WB NB SB	60 38 65 38	109 337 258 135	14 103 41 28	183 478 364 201	87 42 66 33	157 423 289 138	24 144 48 28	268 609 403 199	27 4 1 -5	48 86 31 3	10 41 7 0	85 131 39 -2	46% 27% 11% -1%	6 6 2 0	37 39 38 38	21 26 24 22	6 7 6 7	D D D D	C C C C	A A A A	25 22 24 23	C C C C	23	С	285 285 785 285	25 25 25 25	150 125 150 75		25 50 25 25	125 225 225 100	285 285 285 285	25 25 25 25	50 100 75 50
Sunwood Dr at Ramsey Blvd Signalized Intersection	EB WB NB SB	91 114 89 12	123 130 242 131	171 31 36 50	385 275 367 193	90 119 114 8	120 128 283 138	172 27 45 58	382 274 442 204	-1 5 25 -4	-3 -2 41 7	1 -4 9 8	-3 -1 75 11	-1% 0% <mark>20%</mark> 6%	0 0 4 1	33 35 45 41	26 25 30 22	6 26 19 6	C D D D	C C C C	A C B A	19 29 33 18	B C C B	26	С	350 225 700 300	25 25 25 25	150 175 250 75		25 25 25 25	150 200 225 100	250 300 300	25 25 25 25	100 200 75 100
TH 10 at Ramsey Blvd Signalized Intersection	EB WB NB SB	46 40 60 309	1315 2060 42 34	67 364 32 123	1428 2464 134 466	53 41 60 282	1398 2001 40 32	67 348 34 115	1518 2390 134 429	7 1 0 -27	83 -59 -2 -2	0 -16 2 -8	90 -74 0 -37	6% -3% 0% -8%	2 2 0 2	103 81 93 120	18 15 100 110	6 13 10 40	F F F F	B B F F	A B B D	21 16 74 98	C B E F	27	С	575 775 300 1000	50 25 50 25	200 150 125 250		100 100 25 25	600 1300 125 250	400 275 225 125	25 25 25 25	50 150 75 250
Bunker Lake Blvd at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	41 116 76 47	249 405 330 180	200 115 87 13	490 636 493 240	39 117 75 52	258 402 320 174	197 114 87 14	494 633 482 240	-2 1 -1 5	9 -3 -10 -6	-3 -1 0 1	4 -3 -11 0	1% 0% -2% 0%	0 0 0 0	32 32 33 32	39 27 23 25	6 6 5 6	C C C C	D C C C	A A A A	26 24 24 26	C C C C	24	С	450 400 425 400	25 25 25 25	125 200 175 125		50 50 25 25	225 275 250 125	300 300 325 350	25 25 25 25	125 75 75 50
McKinley St. at Sunfish Lake Blvd Stop Controlled	EB WB NB SB	30 100 50 5	1 1 363 518	55 61 19 1	86 162 432 524	29 152 58 2	1 1 373 480	54 71 16 1	84 224 447 483	-1 52 8 -3	0 0 10 -38	-1 10 -3 0	-2 62 15 -41	-2% 38% 3% -8%	0 4 1 2	62 726 44 6	16 97 7 8	44 679 6 1	F F E A	C F A A	E F A A	50 708 11 8	E F B A	138	F	125 325	25 975 25 25	200 1925 300 25	75	25 975 25 25	200 1925 50 25	175 325	50 1000 25 25	200 1950 125 25
TH 10 at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	95 44 12 538	1668 2300 16 23	13 321 25 171	1776 2665 53 732	91 42 9 502	1646 2338 16 21	12 338 25 159	1749 2718 50 682	-4 -2 -3 -36	-22 38 0 -2	-1 17 0 -12	-27 53 -3 -50	-2% 2% -6% -7%	1 1 0 2	164 132 81 301	19 68 100 278	10 54 21 290	F F F	B E F F	B D C F	26 67 57 298	C E E F	84	F	750 700 150 675	100 50 25 375	325 200 75 1200		100 1350 25 25	625 3800 75 275	250 675 175 225	25 700 25 75	25 2850 75 400
Riverdale Dr at Sunfish Lake Blvd Stop Controlled	EB WB SB	42 10	7 6	10 67	49 16 77	41 16	6 6	9 60	47 15 76	-1 0 6	-1 0 0	0 -1 -7	-2 -1 -1	-4% -6% -1%	0 0 0	1 - 10	1 0 -	- 1 9	A - B	A A -	- A A	1 0 9	A A A	5	A		0 25	0 150		0 0	0 0		0 25	0 150

Table A5. 2045 NO Dullu Alvi Peak Hour	Table /	A5. :	2045	No	Build	AM	Peak	Hour
--	---------	-------	------	----	-------	----	------	------

Table A5. 2045 No Build AM Peak Hour 7:00-8:00am																													Traffic	: Queuing	g (feet)			
			Deman	d volume:	S		Modeled	Volume	s		Мос	lel - Dem	and			To Move	otal Delay ement (se	v by c/veh)	Level N	l of Servic ⁄Iovement	e by t	LOS by A	pproach	LC	os		Left Turn		Thi	ough Que	eue	R	ight Turn	
Location	Aprch	L	т	R	Total	L	т	R	total	L	т	R	Total	%	GEH	L	т	R	L	т	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St Stop Controlled	EB WB NB SB	31 102 156 13	2359 1526 48 22	78 18 38 43	2468 1646 242 78	14 4 0 0	1346 235 0 0	56 6 0 0	1416 245 0 0	-17 -98 -156 -13	-1013 -1291 -48 -22	-22 -12 -38 -43	-1052 -1401 -242 -78	-43% -85% -100% -100%	24 46 22 12	145 3749 3600 3600	82 853 3600 3600	41 994 3600 3600	F F F F	F F F F	F F F	81 904 3600 3600	F F F F	211	F	250 300	25 10950 1000 2825	75 18975 1000 2850		900 2200 1000 2825	1825 2425 1000 2850	225 250	900 900 1000 2825	1825 1825 1000 2875
TH 10 at Alpine Dr Stop Controlled	EB WB SB	73 103	2339 1533	36 84	2412 1569 187	7 13	1228 294	12 11	1235 306 24	-66 -90	-1111 -1239	-24 -73	-1177 -1263 -163	-49% -80% -87%	28 41 16	14 0 63	96 775 0	0 726 456	B A F	F F A	A F F	96 773 243	F F F	250	F	375 225	3400 675	4800 850		1500 6250	2550 10900	275 225	0 675	0 850
Armstrong Blvd at Alpine Dr Stop Controlled	EB WB NB SB	12 40 64 5	56 98 120 492	366 1 10 35	434 139 194 532	8 36 55 6	41 96 108 489	276 1 10 34	325 133 173 529	-4 -4 -9 1	-15 -2 -12 -3	-90 0 0 -1	-109 -6 -21 -3	-25% -4% -11% -1%	6 1 2 0	709 110 11 1	706 62 6 0	609 106 4 0	F F B A	F F A A	F F A A	624 75 8 0	F F A A	184	F		2200 75 25 25	3625 325 100 25		2200 75 0 0	3625 325 0 0	275 250	2225 75 0 0	3650 325 0 0
Armstrong Blvd at Bunker Lake Blvd Signalized Intersection	EB WB NB SB	20 302 21 555	54 27 87 340	37 87 266 3	111 416 374 898	21 288 17 496	51 27 65 304	39 89 215 4	111 404 297 804	1 -14 -4 -59	-3 0 -22 -36	2 2 -51 1	0 -12 -77 -94	0% -3% -21% -10%	0 1 4 3	49 43 59 49	46 34 31 3	2 7 13 3	D D E D	D C C A	A A B A	31 34 19 31	C C B C	30	С	300 225 325 300	25 50 25 200	100 225 50 775		25 25 25 25	175 75 75 275	300 300 285 300	25 25 25 0	50 75 175 0
147th St at Armstrong Blvd Signalized Intersection	EB WB NB SB	25 120 4 94	17 4 314 570	51 32 220 15	93 156 538 679	24 119 4 84	17 5 244 531	51 30 170 13	92 154 418 628	-1 -1 0 -10	0 1 -70 -39	0 -2 -50 -2	-1 -2 -120 -51	-1% -1% <mark>-22%</mark> -8%	0 0 5 2	28 22 29 26	30 15 11 8	9 19 5 3	C C C C	C B B A	A B A A	18 21 9 10	B C A B	12	В	200 275 300 350	25 25 25 25 25	75 100 50 125		25 25 25 25	75 25 125 250	200 275 300 175	25 25 25 25	75 75 100 25
WB TH 10 Ramps at Armstrong Blvd Signalized Intersection	WB NB SB	143 159	421 465	108 276	251 580 741	92 130	347 434	71 268	163 477 702	-51 -29 0	0 -74 -31	-37 0 -8	-88 -103 -39	-35% -18% -5%	6 4 1	39 28	3 16	9 9	D C A	A A B	A A A	26 10 14	C A B	14	В	600 350	25 25	175 150		0 25 25	0 150 200	600 250	25 25	75 200
EB TH 10 Ramps at Armstrong Blvd Stop Controlled	EB WB NB SB	385 26 22 95	40 26 82 104	22 125 80 409	447 177 184 608	277 25 30 80	28 27 82 88	20 120 77 357	325 172 189 525	-108 -1 8 -15	-12 1 0 -16	-2 -5 -3 -52	-122 -5 5 -83	-27% -3% 3% -14%	6 0 0 3	114 16 8 1	63 18 0 5	14 7 1 5	F C A A	F C A A	B A A A	4 3 1 13	A A A B	31	D	225 200 275	350 25 25 0	1975 75 50 0		25 25 0 0	50 75 0 0	225 225 275	25 0 0 0	75 0 0 0
Bunker Lake Blvd at Ramsey Blvd Signalized Intersection	EB WB NB SB	25 43 46 130	368 108 90 433	38 31 34 50	431 182 170 613	24 41 42 123	365 106 91 423	38 30 32 53	427 177 165 599	-1 -2 -4 -7	-3 -2 1 -10	0 -1 -2 3	-4 -5 -5 -14	-1% -3% -3% -2%	0 0 0 1	40 43 37 36	25 23 25 21	13 5 6 6	D D D D	C C C C	B A A A	25 25 24 23	C C C C	24	С	285 285 785 285	25 25 25 50	75 100 125 200		50 25 25 50	175 100 100 275	285 285 285 285	25 25 25 25	75 50 75 50
Sunwood Dr at Ramsey Blvd Signalized Intersection	EB WB NB SB	43 33 200 78	175 159 154 322	168 27 85 142	386 219 439 542	40 32 184 76	167 151 147 299	163 30 87 141	370 213 418 516	-3 -1 -16 -2	-8 -8 -7 -23	-5 3 2 -1	-16 -6 -21 -26	-4% -3% -5% -5%	1 0 1 1	41 62 44 62	27 27 24 71	35 26 10 45	D E D E	C C C E	C C B D	32 32 30 62	C C C E	37	D	350 225 700 300	25 25 50 25	125 100 400 175		25 50 25 125	275 325 125 375	250 300 300	50 50 25 25	175 325 100 250
TH 10 at Ramsey Blvd Signalized Intersection	EB WB NB SB	125 45 35 460	2434 1112 60 32	104 376 75 71	2663 1533 170 563	113 46 26 426	2276 1105 39 23	95 382 55 63	2484 1533 120 512	-12 1 -9 -34	-158 -7 -21 -9	-9 6 -20 -8	-179 0 -50 -51	-7% 0% <mark>-29%</mark> -9%	4 0 4 2	284 98 443 274	212 21 519 757	185 12 793 335	F F F	F C F F	F B F F	214 21 628 303	F C F F	164	F	575 775 300 1000	75 50 25 150	325 200 100 600		4000 75 175 100	6000 525 700 250	400 275 225 125	25 25 550 100	50 250 975 250
Bunker Lake Blvd at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	21 112 193 115	547 297 137 340	146 37 96 25	714 446 426 480	22 111 193 113	537 283 136 338	142 35 109 25	701 429 438 476	1 -1 0 -2	-10 -14 -1 -2	-4 -2 13 0	-13 -17 12 -4	-2% -4% 3% -1%	0 1 1 0	36 35 57 34	46 28 27 29	9 5 8 6	D D E C	D C C C	A A A A	38 28 28 29	D C C C	34	С	450 400 425 400	25 50 75 25	75 200 350 200		100 50 25 50	550 225 150 200	300 300 325 350	25 25 25 25	125 50 100 75
McKinley St. at Sunfish Lake Blvd Stop Controlled	EB WB NB SB	0 40 72 42	0 5 410 492	35 16 131 0	35 61 613 534	0 40 76 46	0 6 430 543	33 14 144 0	33 60 650 589	0 0 4 4	0 1 20 51	-2 -2 13 0	-2 -1 37 55	-6% -2% 6% 10%	0 0 1 2	0 35 7 15	0 33 2 0	9 21 2 0	A D A C	A D A A	A C A A	9 31 3 2	A D A A	4	A	125 325	25 25 25 25	50 125 100 100	75	25 25 25 25	50 125 25 50	175 325	25 25 25 25	75 150 50 50
TH 10 at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	110 38 43 526	2749 1372 49 20	45 454 153 118	2904 1864 245 664	108 42 40 481	2619 1417 68 20	44 474 170 113	2771 1933 278 614	-2 4 -3 -45	-130 45 19 0	-1 20 17 -5	-133 69 33 -50	-5% 4% 13% -8%	2 2 2 2	147 122 244 101	100 45 310 78	96 16 222 34	F F F	F D F E	F B F C	101 39 247 88	F D F F	86	F	750 700 150 675	75 50 75 175	325 200 525 525		4975 300 200 25	6100 1800 575 175	250 675 175 225	25 50 350 25	50 875 600 225
Riverdale Dr at Sunfish Lake Blvd Stop Controlled	EB WB SB	235 20	16 0	10 83	251 10 103	251 27	20 0	10 80	271 10 107	16 0 7	4 0 0	0 0 -3	20 0 4	8% 0% 4%	1 0 0	174 18	160 0	42 13	F A C	F A A	A E B	173 42 14	F E B	126	F		350 25	550 175		350 0	525 0		0 25	0 175

Table A0. 2045 NO Bullu FIVI Feak Houl	Table A	46. 2045	No Build	PM Peak	Hour
--	---------	----------	----------	---------	------

Table A6. 2045 No Build PM Peak Hour 4:15-5:15pm	ſ										[	Traffic Queuing (feet)																						
Location Ar	Aproh		Demand volumes			Modeled Volumes			Model - Demand					CEU	Total Delay by Movement (sec/veh)			Level of Service by LOS by Movement Approach			by oach	LOS		Left Turn			Through Queue			Right Turn				
Location	Аргсп	L	т	R	Total	L	т	R	total	L	т	R	Total	%	GLH	L	т	R	L	т	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St Stop Controlled	EB WB NB SB	29 49 144 65	1945 2423 18 18	98 55 115 29	2072 2527 277 112	18 1 1 1	907 1358 0 0	63 63 0 0	988 1422 1 1	-11 -48 -143 -64	-1038 -1065 -18 -18	-35 8 -115 -29	-1084 -1105 -276 -111	-52% -44% -100% -99%	28 25 23 15	425 681 1773 1937	17 119 0 0	20 20 726 0	F F F F	C F A A	C C F A	24 124 1773 1937	C F F F	82	F	250 300	75 750 975 1025	200 1175 1000 1625		900 1750 975 1025	1825 2450 1000 1625	225 250	900 900 1000 1025	1825 1825 1000 1625
TH 10 at Alpine Dr Stop Controlled	EB WB SB	226 96	2060 2461	145 106	2286 2606 202	39 2	724 1500	87 16	763 1587 18	-187 0 -94	-1336 -961 0	0 -58 -90	-1523 -1019 -184	-67% -39% -91%	39 22 18	137 154	45 222	248 171	F	E F	F	50 224 169	E F F	170	F	375 225	2000 0 675	3075 0 850		1550 4650 0	2525 10325 0	275 225	0 25 675	0 25 850
Armstrong Blvd at Alpine Dr Stop Controlled	EB WB NB SB	26 29 300 12	142 77 615 190	112 22 100 12	280 128 1015 214	16 24 290 11	94 79 607 188	82 20 100 17	192 123 997 216	-10 -5 -10 -1	-48 2 -8 -2	-30 -2 0 5	-88 -5 -18 2	-31% -4% -2% 1%	6 0 1 0	747 294 14 9	706 215 13 1	678 215 9 0	F F B A	F F B A	F F A A	697 13 231 1	F B F A	115	F		1600 200 25 25	2675 550 525 100		1600 200 25 0	2675 550 100 0	275 250	1625 200 25 0	2700 550 100 0
Armstrong Blvd at Bunker Lake Blvd Signalized Intersection	EB WB NB SB	5 261 25 115	15 64 421 176	30 673 288 40	50 998 734 331	6 259 19 98	13 15 328 164	30 669 219 40	49 943 566 302	1 -2 -6 -17	-2 -49 -93 -12	0 -4 -69 0	-1 -55 -168 -29	-2% -6% -23% -9%	0 2 7 2	46 34 57 46	39 33 25 1	2 16 11 1	D C E D	D C C A	A B B A	17 21 20 16	B C C B	20	В	300 225 325 300	25 50 25 50	50 200 75 225		25 25 25 0	100 50 175 0	300 300 285 300	25 75 25 0	50 525 175 0
147th St at Armstrong Blvd Signalized Intersection	EB WB NB SB	16 200 25 89	10 10 566 370	30 152 225 8	56 362 816 467	15 200 16 76	10 10 406 372	30 148 170 8	55 358 592 456	-1 0 -9 -13	0 0 -160 2	0 -4 -55 0	-1 -4 -224 -11	-2% -1% <mark>-27%</mark> -2%	0 0 8 1	30 21 30 29	33 17 13 12	9 21 6 4	C C C C	C B B B	A C A A	19 21 12 15	B C B B	15	В	200 275 300 350	25 25 25 25 25	50 125 75 150		25 25 25 25	50 50 175 200	200 275 300 175	25 25 25 25 25	75 200 125 50
WB TH 10 Ramps at Armstrong Blvd Signalized Intersection	WB NB SB	205 215	545 300	271 300	476 760 600	153 170	397 289	194 309	347 567 598	-52 -45 0	0 -148 -11	-77 0 9	-129 -193 -2	-27% -25% 0%	6 7 0	40 32	5 18	12 13	D C A	A A B	B A B	24 13 16	C B B	17	В	600 350	50 50 0	250 225 0		0 50 25	0 225 175	600 250	25 0 25	100 0 300
EB TH 10 Ramps at Armstrong Blvd Stop Controlled	EB WB NB SB	306 10 61 81	82 26 302 288	37 152 20 158	425 188 383 527	117 9 59 97	27 26 299 161	8 150 22 185	152 185 380 443	-189 -1 -2 16	-55 0 -3 -127	-29 -2 2 27	-273 -3 -3 -84	-64% -2% -1% -16%	16 0 0 4	744 30 6 1	602 22 0 2	412 7 1 2	F D A A	F C A A	F A A A	251 4 3 4	F A A A	95	F	225 200 275	1000 25 25 0	2700 50 100 0		25 25 0 0	100 100 0 0	225 225 275	25 0 0 0	50 0 0 0
Bunker Lake Blvd at Ramsey Blvd Signalized Intersection	EB WB NB SB	79 58 80 45	145 405 316 168	18 122 64 34	242 585 460 247	76 54 71 47	141 396 284 164	20 131 60 33	237 581 415 244	-3 -4 -9 2	-4 -9 -32 -4	2 9 -4 -1	-5 -4 -45 -3	-2% -1% -10% -1%	0 0 2 0	36 36 38 37	23 27 22 22	6 7 6 7	D D D D	C C C C	A A A A	26 24 22 23	C C C C	23	С	285 285 785 285	25 25 25 25	150 150 175 100		25 50 25 25	125 200 175 125	285 285 285 285	25 25 25 25	50 100 75 50
Sunwood Dr at Ramsey Blvd Signalized Intersection	EB WB NB SB	114 125 137 15	142 167 265 141	260 36 45 66	516 328 447 222	113 125 143 12	131 170 267 149	267 35 46 77	511 330 456 238	-1 0 6 -3	-11 3 2 8	7 -1 1 11	-5 2 9 16	-1% 1% 2% 7%	0 0 0 1	38 42 49 43	28 29 29 27	7 28 19 6	D D D D	C C C C	A C B A	19 34 34 21	B C C C	27	С	350 225 700 300	50 50 50 25	175 225 250 75		25 50 25 25	175 300 175 125	250 300 300	25 50 25 25	150 300 100 100
TH 10 at Ramsey Blvd Signalized Intersection	EB WB NB SB	73 46 75 345	1618 2424 55 43	84 438 60 183	1775 2908 190 571	58 37 76 312	1150 1929 54 41	60 341 59 181	1268 2307 189 534	-15 -9 1 -33	-468 -495 -1 -2	-24 -97 -1 -2	-507 -601 -1 -37	-29% -21% -1% -6%	13 12 0 2	124 79 93 160	31 15 125 100	18 12 12 49	F E F F	C B F F	B B B D	34 16 77 118	C B E F	36	D	575 775 300 1000	50 25 50 25	225 125 125 275		75 100 50 25	800 1075 200 325	400 275 225 125	25 25 25 25	75 150 100 325
Bunker Lake Blvd at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	57 130 103 51	294 493 361 196	251 124 99 15	602 747 563 262	61 126 86 55	307 493 302 189	240 120 84 17	608 739 472 261	4 -4 -17 4	13 0 -59 -7	-11 -4 -15 2	6 -8 -91 -1	1% -1% -16% 0%	0 0 4 0	35 32 36 33	37 30 27 26	7 6 7 6	C C D C	D C C C	A A A A	25 27 27 27 27	C C C C	26	С	450 400 425 400	25 25 25 25	125 250 225 150		50 75 50 25	300 350 300 150	300 300 325 350	25 25 25 25	150 100 100 50
McKinley St. at Sunfish Lake Blvd Stop Controlled	EB WB NB SB	35 125 60 5	1 1 435 597	85 68 60 5	121 194 555 607	35 134 55 6	2 0 371 544	82 52 22 4	119 186 448 554	0 9 -5 1	1 -1 -64 -53	-3 -16 -38 -1	-2 -8 -107 -53	-2% -4% -19% -9%	0 1 5 2	95 1234 45 4	17 0 6 10	109 1239 5 1	F F E A	C A A B	F F A A	103 1235 11 10	F F B B	192	F	125 325	100 1800 25 25	450 1850 225 25	75	100 1800 25 25	450 1850 50 50	175 325	100 1850 25 25	450 1875 25 50
TH 10 at Sunfish Lake Blvd Signalized Intersection	EB WB NB SB	110 90 24 647	2054 2711 25 30	50 390 56 188	2214 3191 105 865	86 76 22 574	1651 2232 23 25	41 339 56 169	1778 2647 101 768	-24 -14 -2 -73	-403 -479 -2 -5	-9 -51 0 -19	-436 -544 -4 -97	-20% -17% -4% -11%	10 10 0 3	142 270 83 120	25 207 108 101	19 180 26 74	F F F	C F F F	B F C E	30 205 57 109	C F E F	130	F	750 700 150 675	75 50 25 475	275 275 100 1325		125 19150 25 25	1100 20225 100 225	250 675 175 225	25 4950 25 75	50 5550 100 400
Riverdale Dr at Sunfish Lake Blvd Stop Controlled	EB WB SB	90 15	11 10	15 155	101 25 170	88 18	11 11	15 125	99 26 143	-2 0 3	0 1 0	0 0 -30	-2 1 -27	-2% 4% -16%	0 0 2	0 14	0 0	0 14	A A B	A A A	A A B	0 0 14	A A B	8	A		0 0 25	0 0 200		0 0 0	0 0 0		0 0 25	0 0 200