Appendix B:
Technical Memos

CITY OF RAMSEY GATEWAY

DEPARTMENT OF TRANSPORTATION

City of RAMSEY

Anoka County
MINNESOTA
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CITY OF RAMSEY GATEWAY

Ramsey Gateway Highway 10 Project

Existing Conditions Memorandum

Final Draft - March 8, 2019

GREATER MN GATEWAY

DEPARTMENT OF TRANSPORTATION

City of RAMSEY

Anoka County
MINNESOTA
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I. Introduction

A. Study Purpose

The City of Ramsey, in partnership with Anoka County and MnDOT, has begun an effort to continue to advance improvement plans for Highway 10. Prior to 2014, Highway 10 was studied numerous times over the previous decades, each time furthering the planning for conversion to a full freeway. Traffic volumes and safety concerns warranted a freeway as the proper vision for this corridor. However, current overall state and federal funding levels make it difficult to achieve the vision of a freeway facility on this portion of Highway 10 within the next 20 years. MnDOT, Anoka County and the cities of Ramsey and Anoka realized the price paid for waiting for funding to construct expensive, comprehensive improvements would be continued congestion, numerous conflict points, and continued severe and fatal crashes. The 2014 Highway 10 Access Planning Study identified multiple high-benefit improvement options that are fiscally responsible so that improvements can be funded, programmed, and implemented incrementally.

Since 2014, the City of Ramsey has continued investment and progress in the Highway 10 corridor through completion of multiple frontage road segments. The City and its partners recognize the time is right to continue this momentum by taking the next step to evaluate the multiple combinations of improvement options recommended in the Highway 10 Access Planning Study. The goal of the Ramsey Gateway Project is to develop a single corridor plan for Highway 10 improvements in Ramsey and an implementation schedule to phase improvements into right-size, achievable projects that can be funded through various sources over time.

The goals of the study are to:

- understand the needs and opportunities
- establish goals and objectives
- develop and evaluate alternatives
- reach a consensus on a recommended corridor plan, and
- develop an implementation plan.

The purpose of this memo is to document existing conditions and issues within the project area identified through a technical analysis of land use, pedestrian and bicycle usage, environmental and cultural resources, and traffic and safety operations. This analysis uncovered several key findings that will be documented in a purpose and need framework and used to guide the development of project goals and objectives as well as the development and evaluation of improvement alternatives.

B. Study Area

Figure 1 illustrates the study area which includes Highway 10 from the Ramsey/Elk River border (west extent) to the Ramsey/Anoka border (east extent). It also includes areas north and south of Highway 10 between Bunker Lake Boulevard (County State Aid Highway (CSAH) 116) and the Mississippi River. Below are some of the key components of the study area:

- **Functional Classification** – Highway 10 is a principal arterial that provides a significant transportation connection from Minneapolis-St. Paul to St. Cloud and Greater Minnesota.

Highway 10 serves as a primary route to northern Minnesota and its tourism industry. Three minor arterial county highways connect to Highway 10 in the study area and include: Armstrong Boulevard (CSAH 83), Ramsey Boulevard (CSAH 56), and Sunfish Lake Boulevard (County Road (CR) 57).

- **Average Daily Traffic (AADT)** – Highway 10 carries an average of 35,000 – 50,000 trips per day
- **Regional/Commuter Connection** – 53% trips in the AM and 48% in the PM pass through Ramsey on Highway 10 without stopping. Highway 10 serves as a major commuting route into and out of the core Twin Cities metro region for large portions of Anoka, Sherburne and Wright Counties. In addition, Highway 10 in one of a few key routes that connects the Twin Cities Metro Area to northern Minnesota. Because of this connection, demands on Highway 10 exceed traditional weekday peak hour travel and include weekends during the summer/fall tourism season as well. For example, on average westbound Highway 10 traffic on Fridays during the summer is 7% higher than a typical weekday and eastbound traffic on Sundays is on average 25% higher than Sundays during non-summer months.
- **Roadway Design** – Highway 10 is a four-lane divided highway with a rural section (no curb and gutter) and a speed limit of 65 mph throughout the extent of the project area.
- **Landscaping** features along the highway are sparse and limited. Medians are grass. Roadside features are typically grass with a few sporadic trees.

II. Relevant Plans and Projects

A. Relevant Plans and Funded Projects

Previous to the 2014 Highway 10 Access Planning Study several State, County, and City plans had been consistently planning for future interchanges, additional local roads, and highway access closures that support conversion of Highway 10 to a freeway facility. This planning dates back to the 1999 Statewide Interregional Corridor Plan in which MnDOT identified Highway 10 through Ramsey as part of the high priority interregional corridors within a 2,900-mile system connecting major regional centers around the state.

In 2009/2010 financial realities and other constraints determined that funding the freeway vision, in the near future, would be difficult thereby leading the Metropolitan Council and MnDOT to shift their investment strategy to focus on lower-cost, high-benefit solutions. The 2014 Highway 10 Access Planning Study successfully responded to the shift in investment by developing lower-cost, high-benefit improvement options for the Cities of Ramsey and Anoka.

The following are highlights of planning directions from the Highway 10 Planning Study relevant to Highway 10 within the City of Ramsey:

- At-grade intersection alternatives and local frontage road connections were recommended from Jarvis Street to the Armstrong Blvd (CSAH 83) interchange.
- The realignment of Highway 10 between Ramsey Boulevard and Sunfish Lake Boulevard, with the construction of a northern frontage road, has been identified as an immediate priority for the Highway 10 Corridor and the City of Ramsey. The extension of the northern frontage road would connect Sunfish Lake Boulevard to Anoka Technical College in the City

of Anoka. This project would provide a local connection from Ramsey to this regional destination, removing local trips from Highway 10.

- Long term planning, or beyond 10 years, would include providing grade separations at Sunfish Lake Boulevard and Ramsey Boulevard intersections.
- As safety demands and opportunity presents itself, the following projects were also recommended for consideration:
    - Extension of Veterans Drive north of Highway 10, creating a continuous frontage road
    - Railroad underpasses at Sunfish Lake Boulevard and Ramsey Boulevard

The following are planning direction or policy highlights from other relevant long-range city, county, and state plans:

City of Ramsey 2040 Comprehensive Plan Update (2018)

- Planned future land uses along the Highway 10 corridor are diverse, ranging from low density residential to commercial to park space. The construction of a business park is a key goal for the City moving forward, as well as removing blight and public nuisances along the corridor.
- The COR (Center of Ramsey) is a mixed-use development surrounding the Ramsey Northstar Transit Station along Highway 10 between Ramsey Boulevard and Armstrong Boulevard. The area is about 50% developed (as of 2018) and is expected to see considerable development over the next 10 years. Planned development is expected to be a combination of office, retail, and public uses.
- The City has identified creating both a corridor and a traffic plan for Highway 10 as a key strategy to improve safety and mobility on the Highway. These strategies include establishing a stakeholder group. The city's priorities at this time include the following:
    - Full Access Grade-Separated Interchange at Sunfish Lake Boulevard/CSAH 57
    - Full Access Grade-Separated Interchange at Ramsey Boulevard/CSAH 56
    - Reduced Conflict U-Turn Intersection at Bowers Drive
    - Reduced Conflict U-Turn Intersection at Alpine Drive
    - Removal of uses on the north side of U.S. highway 10/169 west of Ramsey Boulevard
    - Pedestrian Bridge on Central Anoka County Regional Trail at Northstar Commuter Rail – Ramsey Station
    - Frontage Roads to support interchange and removal of private, direct accesses on U.S. Highway 10/169

Anoka County 2040 Transportation Plan (2018)

- The Highway 10 intersection with Sunfish Lake Boulevard is one of the top 10 high crash locations in the County, demonstrating the need for safety improvements. The intersection of Highway 10 and Ramsey Boulevard is 26th is also on the high intersection crash list.
- In modeling 2040 traffic volumes and highway network, the County modeled two scenarios – one baseline and an alternative where US Highway 10 is converted to a freeway. The alternative analysis showed that much of the traffic using adjacent, parallel routes to avoid

congestion would instead remain on Highway 10, alleviating traffic on county and local roads.

Met Council and MnDOT Principal Arterial Intersection Conversion Study (2017)

- Study considered needs at intersections on non-freeway principal arterials, like Highway 10, to set priorities for grade separations.
- High-priority intersections are those that often exhibit needs that can justify high-capacity at-grade improvements or grade-separation. Highway 10/Sunfish Lake Boulevard was identified as a high-priority intersection.
- Low-priority intersections generally do not require major changes or projects based on current demand and any problems can most likely be addressed with at-grade projects. However, some low-priority intersections are located on corridors near medium- and high-priority intersections or may be in growth areas. Highway 10 at Ramsey Boulevard was identified as a low-priority intersection.

MnDOT Rail & Safety Coordination

- MnDOT does not specifically rank railroad grade separation priorities, but to identify a tier of initiatives, they consider project readiness, available funding streams, and constructability as the driving factory that would lead to project construction.
- With that understanding, the MnDOT rail safety department, has identified both Ramsey Boulevard (second place) and Sunfish Lake Boulevard (third place) as in the top tier of currently unfunded railroad grade separations.
- Ferry Street (TH 47) is currently at the top of the tier because of a recent feasibility study and current political efforts.

B. Funded Projects

It is anticipated that by 2022 the following funded projects will be under construction. Each is described below and have been incorporated into the future traffic operations analyses.

1. **Anoka Highway 10 Project** is planned to begin in 2022. Project elements include (see **Appendix B**):
    - Thurston Avenue traffic signal will be removed and replaced with an interchange
    - Fairoak Avenue traffic signal will be removed and replaced with an underpass
    - West Main Street will be extended
    - All other access points on the highway within the project area will be removed
    - Local frontage roads will be improved to provide connectivity for local trips
2. **Elk River Highway 169 Freeway Vision** was recently awarded funding through the Corridors of Commerce program. See **Appendix B** for the preferred alternative that transitions Highway 169 from the existing at-grade expressway facility to a limited access grade-separated freeway facility between Highway 10 in Elk River and CSAH 4 in Zimmerman, including redesign of Highway 10/101/169 system interchange. The project also includes improvements to Highway 101 from Highway 169 in Elk River to CSAH 39 in Otsego, with reconstruction of the Highway 101 bridge over the Mississippi River. A system of interchanges, overpasses, and frontage/backage roads will replace existing at-grade intersections. Interchanges will be constructed at the following locations: Main Street,

School Street, Jackson Avenue/193rd Avenue/197th Avenue, and 221st Avenue in Elk River; at CSAH 25/19 in Livonia Township; and at CSAH 4 in Zimmerman. This project will result in consolidation and closure of other access locations along Highway 169. Additionally, the City of Ramsey secured $3.5M for design of railroad grade separation at Ramsey Blvd. The timing of construction is unknown but will be considered along with roadway improvements in this study.

C. Other Relevant Projects

1. The Anoka County 2040 Transportation Plan identifies a potential **turnback of CSAH 5** from CR 57 to Highway 47. This is identified as a long-term potential jurisdictional transfer in the year 2030+. The city has expressed the desire to jointly complete a corridor study to achieve a long-term plan prior to any potential jurisdictional transfer of this corridor south/east of Sunfish Lake Boulevard/CSAH 57. The Ramsey Gateway Project will consider this turnback as traffic forecasting is completed to identify any potential impacts on Ramsey Boulevard and Sunfish Lake Boulevard traffic patterns.

2. A **potential future Dayton-Ramsey river crossing** has been previously discussed for many years. Ramsey's Transportation Plan aligns Armstrong Boulevard/CSAH 83 to serve as the corridor for the future Mississippi River Crossing, and coincides with Zanzibar Lane in the City of Dayton. MnDOT and the communities are no longer identifying right-of-way preservation for this river crossing due to lack of available funding. The timeframe for implementing this future river crossing is beyond the 2045 planning horizon of the Ramsey Gateway project. Therefore, the crossing is not included in the 2045 traffic forecasting assumptions.

3. The proposed **Regional Mississippi Skyway Multiuse Bridge** (see *Appendix B*) is an extension of an existing skyway that connects over Veteran's Drive between an 800-stall public parking ramp and the rail station. The proposed pedestrian and bicycle bridge would establish a new north-south bikeway across Highway 10 in the center of Ramsey, consistent with a planned regional bikeway. Anoka County worked jointly with the city to realign the Central Anoka County Regional Trail to utilize the bridge to safely connect CSAH 116 (Bunker Lake Boulevard), the Ramsey Northstar Station, and the MRT – through the center of the COR. The schedule for developing the proposed pedestrian and bicycle bridge is unknown and will depend upon funding availability.

4. The **Resilient Communities Project (RCP)** is a program at the University of Minnesota's Center for Urban and Regional Affairs (CURA) that connects University faculty and students with Minnesota communities to address strategic projects that advance local resilience and sustainability. The RCP partnered with City of Ramsey Staff and community stakeholders to study Highway 10 Corridor Planning issues and needs. The goal of the project was to assist with ongoing development of the City's U.S. Highway 10 Corridor Plan by assessing potential future land uses in the corridor, investigating incentive-based approaches to encourage building and site improvements, and identifying existing and emerging models for multimodal highway corridor planning.

5. In 2016, a joint study for **Trunk Highway 47** was initiated covering the cities of Ramsey and Anoka. This plan was never fully adopted, and many of these alternatives are no longer valid. The city recommended Anoka County take the lead on reviving this study in 2019 to advance alternatives. Recently, Anoka County applied for STIP funds for the intersection of

Bunker Lake Boulevard/CSAH 116 and Saint Francis Boulevard/TH 47. The results of the application are unknown at this time.

III. Demographics

The City of Ramsey had a population of 18,510 at the 2010 US Census reporting period. The American Community Survey (ACS) estimates the 2016 population at 26,251. Based on forecasts by the Metropolitan Council, the 2040 population of Ramsey is projected to be approximately 35,000.

The Minnesota Department of Employment and Economic Development (DEED) estimates approximately 6,334 jobs exist in the City of Ramsey as of 2016.

General demographic information from the City's Draft 2040 Comprehensive Plan is summarized below in *Table 1* below:

Table 1. Ramsey Population and Employment Information

		2016	2020	2030	2040 Forecast	2040 Amended Request
Households		8,973	9,500	11,500	13,000	13,500
Population		26,251	27,550	33,350	34,700	39,150
Employment		6,334	6,900	7,800	7,600	8,400

The City of Ramsey and Metropolitan Council are currently working on developing an agreement for 2040 population, households and employment forecasts. Both agree the 2040 forecasts are likely low based on the rate of recent growth. The 2040 amended request forecasts are the latest proposed by the City and are awaiting Metropolitan Council approval.

Figure 2 shows Ramsey as having areas of medium to high population density by 2040 as identified by the Anoka County 2040 Transportation Plan.

Elk River is located adjacent to the western portion of the study area and is projected to see significant growth over the next few decades as well. Elk River's 2015 population was 23,172 and is projected to grow to 34,890 by 2035. Sherburne County as a whole has also experienced unprecedented growth over the past decade and is projected to continue to grow from a county population of 88,499 to 122,000 by 2030, according to the County's Comprehensive Transportation Plan.

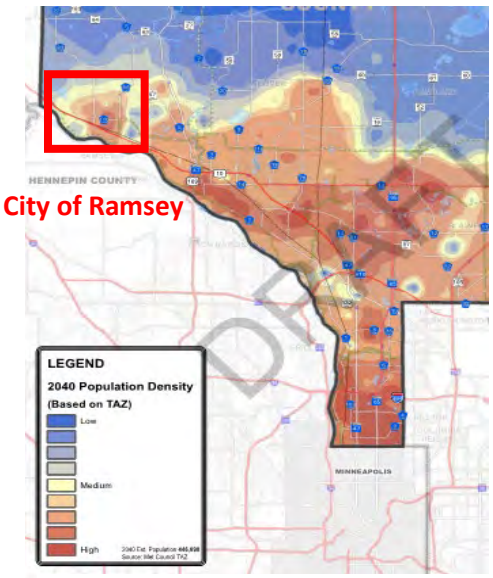


Figure 2 - Anoka County 2040 Population Density

IV. Land Use

Existing and future land uses in the study area are shown on *Figures 3* and *4*, and described below.

A. Existing Land Use

Ramsey

The City of Ramsey encompasses approximately 29 square miles, approximately 8,000 acres of land is developed with over 1,000 acres of land open for development as per the City's Draft 2040 Comprehensive Plan. Land use along the Highway 10 Corridor ranges from commercial, industrial, and institutional in the more densely developed east and central segments to commercial development interspersed with agricultural uses and open space in the west. Residential uses exist immediately beyond the commercial and industrial uses both north and south of the corridor. A large, centrally located, portion of land north of the corridor and the railroad is undeveloped.

While planning for a conversion of Highway 10 to a freeway, the city had completed several plans, adopted official maps and advanced the purchase of over $8 million worth of right-of-way needed for access improvements and expansion of Highway 10. Properties purchased by the City of Ramsey through the Metropolitan Council's Right-of-Way Acquisition Loan Fund (RALF) for future Highway 10 related right-of-way needs are illustrated in *Figure 5*. Many businesses and potential developers interested in property along Highway 10 in Ramsey are uncertain whether or not to invest further into these areas until right-of-way needs for future roadway improvements are known.

Elk River

Existing land uses along Highway 10 in Elk River (adjacent to the study area) include a mix of highway business, industrial, undeveloped lands and rural residential units along the river.

B. Future Land Use

The future (planned) land use map is referenced from the City of Ramsey 2040 Comprehensive Plan Update and illustrates several proposed shifts in land use.

1. Beginning on the eastern end of the corridor, the map identifies a shift from commercial to business park and also conversion of low density residential and undeveloped land to mixed use.
2. The property containing the manufactured home park is guided for commercial use.
3. The centrally located, undeveloped land north of the corridor is guided for mixed-use development from its current undeveloped state.
4. Current agricultural uses south of the corridor on the western end are guided for low density residential and some mixed-use.
5. A shift from agricultural to business and medium density residential is identified north of the corridor on the west end.

Opened in the fall of 2012, the Ramsey station on the Northstar Commuter Rail line is just north of the corridor between Armstrong Boulevard and Ramsey Boulevard became the catalyst for a large amount of ongoing development and potential redevelopment on the west side of the city. The

COR development is a 400-acre area which is planned to include residential, commercial, retail, educational, and recreational land uses. It is intended to serve as the downtown of Ramsey. A conceptual map of the COR development developed by the City of Ramsey is attached in **Appendix B**. Development of the COR site is underway, including government, commercial, and residential buildings. *Table 2* breaks down the City projections for land use development for the full COR site:

Table 2. Planned Land Use in COR Site

Use	Acres
Parks and amenities	45
Retail	70
Mixed Use	28
Business Park	15
Residential	16
Other Commercial	30
Other Residential	27
Total Developable	**231**

The 2040 Draft Comprehensive Plan notes The COR development status is; 70% of residential units built, 35% of office built, 15% of retail built, and 35% of public spaces built.

Elk River

Future land use along the portion of Highway 10 in Elk River adjacent to the study area is projected to continue to see highway business and industrial uses along with low-density residential uses near the river. City of Elk River staff report this area is outside of the city's current sewer capacity service area and therefore will be limited in development density until it can be served at a future date.

V. Environmental Screening

A social, environmental, and economic (SEE) scan of the study area was conducted to identify existing built and natural resources that require consideration as transportation alternatives are developed and evaluated. This scan was conducted to identify issues at a screening level and to document big picture or fatal-flaw constraints that may influence development of alternatives.

A. Cultural Resources

MnDOT's Cultural Resource Unit was contacted to provide a historical/archaeological review of the project area. A preliminary literature review identified the following archaeology and architectural history resources within the study area:

1. A survey conducted by the 106 Group in 2008 recommended that the St. Paul & Northern Pacific Railroad/BNSF Railroad - Sauk Rapids to Minneapolis (SHPO no. AN-RMC027) is eligible for the National Register of Historic Places (NRHP) for its significant role in the development of the railroad transportation system in Minnesota.
2. There are 20+ properties known to be of historical significance within the project area according to the State Historic Preservation Office (SHPO) database. *Figure 6* illustrates

these locations including locations with the following historical contexts:

a. Early Agricultural and River Settlement 1840 -1870
b. Railroad Development in Minnesota 1862 – 1956
c. Railroads and Agricultural Development 1870 - 1940

It is possible that additional survey and evaluation efforts may be needed to understand the potential for impacts to these resources with individual projects.

B. Environmental Justice

Oak Terrace Estates, a manufactured home park, is located at Highway 10 and McKinley Street and represents potential for low income and/or minority populations. Population statistics are aggregated to the "Place" level limiting the extent to the entire city of Ramsey. The city exhibits the following characteristics; 8.8% of the population is 65 and over and 8.5% of the population is non-white. Any potential impacts to environmental justice populations will be considered in future environmental review.

C. Parks and Recreation Areas (Section 4f/6f Resources)

1. Section 4(f) resources in the Study Area are shown on *Figure 6* and include parks and recreation areas, school playgrounds, wild and scenic rivers, trails, and public golf courses.

2. One Section 6(f) resource lies adjacent to the southeast edge of the Study Area as shown on *Figure 6*. These recreational facilities have been funded with Land and Water Conservation (LAWCON) funds and/or state recreation grant funds from the Minnesota Department of Natural Resources (MNDNR) requiring compliance with LAWCON grant guidelines, including sole use for outdoor recreation. Conversion from recreational use requires replacement. The Mississippi River Community Park is the only Section 6(f) property near the project area located in the city of Anoka.

D. Water Resources

The Mississippi River within the Study Area is part of the Mississippi National River & Recreational Area (MNRRA) Critical Area Corridor. The MNRRA is administered by the National Park Service with oversight of the Minnesota Critical Area delegated to the Minnesota Department of Natural Resources (MNDNR). Local units of government within the critical area are required to adopt critical area plans and regulations that comply with state critical area standards and guidelines. Local critical area plans and ordinances are subject to the review and approval of the MNDNR and the Metropolitan Council. See *Figure 7* for illustrated water resources and protected waters in the study area.

Wetlands and surface water resources in the Study Area are shown on *Figure 7*. There are no large lakes within the Study Area. However, wetland habitat, including Public (Protected) Waters and Protected Water Wetlands, is extensive throughout the northern portion of the Study Area and along the riparian river corridors. The developed areas immediately along the Highway 10 corridor have little remaining wetland habitat.

E. Wells and Potential Contamination

1. Known history of contamination in the project area. MPCA "What's in My Neighborhood?"

sites that are located near the corridor can be seen in *Figure 8*. More detailed investigations may be recommended for properties with existing/past land uses that may have used hazardous/chemical waste as improvement projects are identified.

2. The Study Area is located in the Anoka Sand Plain, characterized by thick surface deposits of sand and gravelly sand providing a ready supply of groundwater for irrigation and a drinking water supply. The City of Ramsey has two Wellhead Protection Areas (WHPA) in the project area as well as the city's Drinking Water Source Management Area (DWSMA). *Figure 8* shows these areas and the existing wells in the Study Area.

F. Utilities

Public and private utilities are located throughout the project area. Common utilities in the project area include phone, electric, gas, water, storm sewer, sanitary sewer, and cable television. Utility information will be considered as alternatives are developed and evaluated.

G. Natural Plant Communities

1. Several Regionally Significant Ecological Areas (RSEAs) have been identified in the Study Area as shown on *Figure 6*. GIS data delineating MNDNR, Division of Wildlife Management Areas (WMA) show that WMA's are non-existent within the project area.

2. The project area is generally dominated by developed industrial and commercial uses with altered vegetation. One MnDNR Native Plant Community is located south of the project corridor on an island on the Mississippi River which is unlikely to be affected by corridor improvements. This can be seen in *Figure 6*.

H. Air Pollution

The project area is located in a Maintenance Area for Carbon Monoxide (CO) and Sulfur Dioxide (SO2). The area is in attainment for the other four criteria pollutants (O3, NO2, lead, and particulate matter).

I. Noise

There are several potential noise receptors adjacent to the corridor consisting of single and multi-family residential (including a manufactured home community), recreation areas, Section 4(f) sites, among others. Potential noise receptors were identified using criteria outlined in the Analysis and Abatement Guidance for Highway Traffic Noise Regulation provided by the Federal Highway Administration (FHWA). Potential noise receptors are illustrated in *Figure 6*. The need for a noise analysis will be determined once individual improvement projects are identified.

J. Wildlife, Threatened and Endangered Species

The US Fish and Wildlife Service (USFWS) identifies two federally protected species known to be in all MN counties that require review and potential mitigation per USFWS guidance. Species include the northern long-eared bat and the rusty-patched bumble bee. Various other rare species are also present near the corridor as identified through the Natural Heritage Information System (NHIS) maintained by the MnDNR.

VI. Existing Traffic Conditions

Traffic operations and safety existing conditions along TH 10 are documented in detail in a project memorandum located in **Appendix C, Ramsey Highway Existing Traffic Conditions Memo**. Key points from the memo are provided below.

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 AADT ranges from 35,000 vehicles on the west end and 51,000 vehicles per day 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 with the grade separation of Fairoak Avenue and Thurston Avenue at Highway 10. To the west of the project in Elk River TH 169 is also planned to be converted to a freeway.

B. Access Inventory

The number of access points along Highway 10 is greater than what is allowed by MnDOT's access spacing guidelines for principal arterials. There is a direct relationship between the density of access points and the safety of an arterial corridor. Currently, there are a total of 73 accesses along the study corridor, impacting the safety and mobility of the corridor. A total of 55 properties have direct access to Highway 10, some with multiple access points to the highway.

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 1AF 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 3* displays the existing primary intersections and which ones meet spacing requirements.

Table 3. Distance Between Primary Intersections

Primary Intersections	Miles	Meets Spacing Recommendation
Jarvis St to Alpine Dr	0.44	No
Alpine Dr to Bowers Dr	1.01	Yes
Bowers Dr to Armstrong Blvd	1.15	Yes
Armstrong Blvd to Ramsey Blvd	1.20	Yes
Ramsey Blvd to Sunfish Lake Blvd	1.09	Yes

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 ½ mile. Tables 4 and 5 below show the what spacing recommendations are met throughout the corridor for secondary intersections.

Table 4. Distance between Secondary Intersections (Eastbound)

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 – 153rd Ave (Full Access)	0.20	FAIL
153rd Ave (Full Access) - Beatty St (Full Access)	0.55	PASS
Beatty St (Full Access) - Bowers Dr	0.30	FAIL
Bowers Dr - Farmer Access (Full Access)	0.10	FAIL
Farmer 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)	0.14	FAIL

Table 5. Distance between Secondary Intersections (Westbound)

Secondary Intersections	Distance Between Secondary Intersections	Category 1A
Business Access (Full Access) - 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 - Farmer Access (Full Access)	1.10	PASS
Farmer Access (Full Access) - Bowers Dr	0.15	FAIL
Bowers Dr - Beatty St	0.25	FAIL
Beatty St - 153rd Ave (Full Access)	0.55	PASS
153rd Ave (Full Access) - Alpine Dr	0.20	FAIL
Alpine Dr - Adams St (RIRO)	0.20	FAIL
Adams St (RIRO) - Jarvis St	0.25	FAIL

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.

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. Secondary intersections that are shown to have low risk may be maintained. The results show that the business access is a high-risk intersection along both eastbound and westbound Highway 10. Intersection sight distance was also analyzed at the secondary intersections. All intersections met the necessary sight distance.

Both primary and secondary intersections were analyzed to determine if recommended spacing from the intersection to the closest driveways are satisfied. Driveways lying within any of these distances are within the intersection functional area meaning safety may be compromised. 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.

C. Safety Analysis

Crash History

A crash review was completed for the intersections in the project area for the previous five years (2013-2017). *Figure 9* summarizes all of the crashes in the project area. There was a total of 277 crashes along Highway 10 within this timeframe. Rear end crashes were the most common accounting for 158 of the 277 total crashes. These rear end crashes are likely caused from queueing along Highway 10 at the Ramsey Blvd and Sunfish Lake Blvd signals.

The observed crash rate at the TH 10 and Sunfish Lake Blvd intersection exceeded the statewide average. Over the past five years there have been 89 crashes that have occurred at this intersection. Rear end crashes were the most common at the intersection with 64 of the 71 rear end crashes occurring along Highway 10. These rear ends are likely caused from excessive queuing at the signal. The observed crash rate was found to be 0.89. The state-wide 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 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.

Fatal Crashes

A ten-year crash analysis (2008-2017) was also 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 Highway 10 at Alpine Drive. The other was a

right-angle crash at the intersection of Highway 10 and McKinley St. There were three fatal pedestrian crashes between 2008 and 2017. These crashes took place at the intersections of Highway 10 and Ramsey Blvd, Highway 10 at Sunfish Lake Blvd and at the business access along Highway 10 between Sunfish Lake Blvd and Thurston Avenue that provides access to Two Rivers Vineyard & Winery, Signs by RSG and Lano Equipment.

Bicycle and Pedestrian Crashes

Bike and pedestrian crashes were analyzed over a five-year period (2013-2017). There was one non-incapacitating 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.

D. Existing Traffic Conditions

Figure 10 shows the existing peak hour turning movement counts. Existing traffic volumes for the area were collected in May of 2018 for all intersections except Highway 10 at Sunfish Lake Blvd and Highway 10 at Ramsey Blvd which were collected in May 2017 for the Highway 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.

A level of service (LOS) analysis of the peak hours was completed using the existing turning movement counts. The LOS results are based on average delay per vehicle 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 6* on the next page and described further in the text that follows.

Table 6. Existing (2018) No-Build Operational Analysis

Location	Peak Hour	Intersection Delay- LOS		Maximum Delay-LOS**		Limiting Movement ***	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
TH 10 at Jarvis St	AM	3	A	235	F	SBT	SBL/T/R	25	125
Stop Controlled	PM	3	A	127	F	SBT	SBL/T	25	150
TH 10 at Alpine St	AM	2	A	27	D	SBL	EBL	25	100
Stop Controlled	PM	5	A	63	F	SBL	EBL	50	175
Armstrong Blvd at Alpine St.	AM	5	A	26	D	WBL	NBL	25	150
Stop Controlled	PM	10	B	30	D	WBL	NBL	25	150
Armstrong Blvd at Bunker Lake Blvd	AM	14	B	47	D	WBL	SBL	50	275
Signalized Intersection	PM	12	B	40	D	EBR	NBT	25	150
Armstrong Blvd at 147th St	AM	7	A	33	C	EBL	WBR	25	150
Signalized Intersection	PM	12	B	26	C	SBL	WBR	25	150
WB TH 10 Ramps at Armstrong Blvd	AM	13	B	26	C	WBR	SBL	25	100
Signalized Intersection	PM	5	A	43	D	WBL	SBR	25	150
EB TH 10 Ramps at Armstrong Blvd	AM	8	A	15	C	EBL	EBL	25	150
Stop Controlled	PM	2	A	14	B	EBL	EBL	25	150
Bunker Lake Blvd at Ramsey Blvd	AM	20	C	38	D	WBL/EBL	SBL/EBT	25	150
Signalized Intersection	PM	20	B	35	C	SBL	WBT	50	225
Sunwood Dr at Ramsey Blvd	AM	21	C	40	D	EBL	NBL	25	225
Signalized Intersection	PM	25	C	45	D	NBL	NBL	25	225
TH 10 at Ramsey Blvd	AM	29	C	351	F	SBT	EBT	125	875
Signalized Intersection	PM	25	C	131	F	EBL	WBT	50	500
Bunker Lake Blvd at Sunfish Lake Blvd	AM	28	C	42	D	EBT	EBT	75	400
Signalized Intersection	PM	23	C	39	D	EBT	WBT	50	250
McKinley St. at Sunfish Lake Blvd	AM	3	A	26	D	WBL	WBR	25	125
Stop Controlled	PM	20	C	113	F	WBL	WBT	125	600
TH 10 at Sunfish Lake Blvd	AM	26	C	139	F	NBL	WBT	100	600
Signalized Intersection	PM	38	D	152	F	EBL	WBT	275	2250
Riverdale Dr at Sunfish Lake Blvd	AM	2	A	10	A	SBL/R	SBL/R	25	75
Stop Controlled	PM	6	A	11	B	SBL/R	SBL/R	25	100

*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 acceptably with LOS C or better during the AM peak hour.
- TH 10 at Jarvis St
  - All northbound movements operate with failing LOS
  - Southbound left and through movements operate with failing LOS
- TH 10 at Ramsey Blvd
  - Northbound, southbound and eastbound left turn movements operate with failing LOS

- Northbound and southbound through movements operate with failing LOS
- Average delay is over two minutes per vehicles for the southbound approach

- TH 10 at Sunfish Lake Blvd
  - Northbound, southbound, and westbound left turn movements operate with failing LOS
  - Southbound through movement operate with failing LOS
  - Average delay is 102 sec/veh for the southbound approach

PM Delay

- Currently all intersections operate acceptably 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
  - Northbound and southbound through movements operate with failing LOS
  - Average delay is 111 sec/veh for the southbound approach
- McKinley St at Sunfish Lake Blvd
  - 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 left turn movements operate with failing LOS
  - Northbound and southbound through movements operate with failing LOS
  - Southbound right movement operates 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.
- Sunwood Dr at Ramsey Blvd
  - Maximum eastbound through queues block the left turn lane during both peak hours.
  - Maximum westbound through queues block the left turn lane during the PM peak hour.
- TH 10 at Ramsey Blvd
  - Maximum eastbound through queues block both turn lanes and driveways 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 and driveways during the PM peak hour.
    - Maximum southbound right 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 were 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.

E. Future Traffic Conditions

A no-build analysis was completed to determine future 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. *Figures 11* and *12* in the *Appendix* show the forecasted turning movement counts for 2025 and 2045, respectively. *Table 7* summarizes the 2025 no build analysis. *Tables A3* and *A4* in the *Appendix* show the detailed results.

Table 7. 2025 No Build Operational Analysis

Location	Peak Hour	Intersection Delay- LOS		Maximum Delay- LOS**		Limiting Movement ***	Max Approach Queue		
							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	C	1347	F	NBL	NBR	675	1000
TH 10 at Alpine St	AM	3	A	29	D	SBL	SBL/R	25	125
Stop Controlled	PM	10	B	147	F	SBL	EBL/SBL	50	275
Armstrong Blvd at Alpine St.	AM	24	C	180	F	WBR	EBR	75	400
Stop Controlled	PM	11	B	25	D	EBL	EBR	25	200
Armstrong Blvd at Bunker Lake Blvd	AM	24	C	49	D	EBL	SBL	125	575
Signalized Intersection	PM	11	B	40	D	EBL/EBT	NBT/SBL	25	125
Armstrong Blvd at 147th St	AM	9	A	30	C	NBL	SBT	25	150
Signalized Intersection	PM	11	B	26	C	EBL	NBT	25	150
WB TH 10 Ramps at Armstrong Blvd	AM	6	A	42	D	WBL	SBR	25	150
Signalized Intersection	PM	4	A	41	D	WBL	WBL	25	200
EB TH 10 Ramps at Armstrong Blvd	AM	3	A	19	C	EBL	EBL	25	175
Stop Controlled	PM	3	A	32	D	EBL	EBL	50	300
Bunker Lake Blvd at Ramsey Blvd	AM	21	C	37	D	WBL	EBT	50	150
Signalized Intersection	PM	23	C	39	D	WBL	WBT	50	225
Sunwood Dr at Ramsey Blvd	AM	23	C	43	D	NBL	NBL	50	425
Signalized Intersection	PM	26	C	45	D	NBL	NBL	25	250
TH 10 at Ramsey Blvd	AM	33	C	480	F	SBT	EBT	150	1050
Signalized Intersection	PM	27	C	120	F	SBL	WBT	100	1300
Bunker Lake Blvd at Sunfish Lake Blvd	AM	29	C	43	D	EBT	EBT	75	450
Signalized Intersection	PM	24	C	39	D	EBT	WBT	50	275
McKinley St. at Sunfish Lake Blvd	AM	3	A	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	C	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	A	10	B	SBL/R	SBL/R	25	75
Stop Controlled	PM	5	A	10	B	SBL	SBL/R	25	150

*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
  - Northbound approach operates with over 24 minutes of delay on average per vehicle
  - Southbound approach operates with over six minutes of delay on average per vehicle
  - Westbound left turn movement operates with a failing LOS
- Alpine Dr at Armstrong Blvd
  - Westbound approach operates with a failing LOS
  - Eastbound left turn movement operates with a failing LOS
- TH 10 at Ramsey Blvd

- 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
  - Northbound, southbound and westbound left turn movements operate with failing LOS
  - Northbound and southbound through movements operate with failing LOS

2025 PM Delay

- All intersections but the following operate acceptably with LOS C or better during the 2025 PM peak hour.
  - Sunfish Lake Blvd at McKinley St
  - TH 10 at Sunfish Lake Blvd
- TH 10 at Jarvis St
  - Northbound approach operates with over 16 minutes of delay on average per vehicle
  - Southbound approach operates with over two minutes of delay on average per vehicle
  - 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
  - All left turn movements operate with failing LOS
  - 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
  - Eastbound left turn movement operates with failing LOS
- TH 10 at Sunfish Lake Blvd
  - All left turn movements operate with failing LOS
  - Northbound and southbound through movements operate with failing LOS
  - Southbound right movement operates with failing LOS
  - 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
    - Maximum eastbound queues block both turn lanes during both peak hours
    - Maximum westbound queues block both turn lanes during the PM peak hour
- Sunfish Lake Blvd at McKinley St
    - Maximum westbound queues extend past Radium St during the PM peak hour
- TH 10 at Sunfish Lake Blvd
    - 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
    - Southbound left turn queue extends past McKinley St during the PM peak hour

Table 8. 2045 No Build Operational Analysis

Location	Peak Hour	Intersection Delay- LOS		Maximum Delay-LOS**		Limiting Movement ***	Max Approach Queue		
							Direction	Average Queue (ft)	Max 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	C	59	E	NBL	SBL	200	775
Signalized Intersection	PM	20	B	57	E	NBL	WBR	75	525
Armstrong Blvd at 147th St	AM	12	B	30	C	EBT	SBT	25	250
Signalized Intersection	PM	15	B	33	C	EBT	WBR	25	200
WB TH 10 Ramps at Armstrong Blvd	AM	14	B	39	D	WBL	SBT/SBR	25	200
Signalized Intersection	PM	17	B	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	C	43	D	WBL	SBT	50	275
Signalized Intersection	PM	23	C	38	D	NBL	WBT	50	200
Sunwood Dr at Ramsey Blvd	AM	37	D	71	E	SBT	NBL	50	400
Signalized Intersection	PM	27	C	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	C	57	E	NBL	EBT	100	550
Signalized Intersection	PM	26	C	37	D	EBT	WBT	75	350
McKinley St. at Sunfish Lake Blvd	AM	4	A	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	A	14	B	SBL/R	SBL/R	25	200

*Delay in seconds per vehicle

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

***Limiting Movement is the highest delay approach

2045 AM Delay

- The following intersections operate with LOS F during the 2045 AM peak hour:
  - 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
  - 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
    - Northbound approach operates with over 10 minutes of delay on average per vehicle
    - Southbound approach operates with over a 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
    - All eastbound and northbound movements operate with failing LOS
    - The southbound left and westbound left movements operate with failing LOS
    - 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:
    - 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
    - Eastbound and westbound left turn movements operate with failing LOS
- TH 10 at Alpine Dr
    - Westbound and southbound approaches operate with failing LOS
- TH 10 EB Ramp at Armstrong
    - Eastbound approach operates with over four minutes of delay on average per vehicle
- TH 10 at Ramsey Blvd

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

2045 Queueing Issues

- TH 10 at Jarvis
  - Queues on all approaches are extensive
  - 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
  - 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
  - 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
- Maximum northbound through queue blocks turn lanes during the AM peak hour

- Sunfish Lake Blvd at Bunker Lake Blvd
  - Maximum eastbound through queue blocks turn lanes during the AM peak hour
- Sunfish Lake Blvd at McKinley St
  - 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
  - Maximum southbound left turn queues extend past McKinley St during the PM peak hour

F. Freight and Transit

The following summarizes freight and transit operations within the study area:

- **Highway Freight** – Highway 10 is identified as a Tier 2 Truck Corridor. A Tier 2 Truck Corridor is the second highest tier of the regional freight network based on a composite score of annual average truck volumes, truck percentage of total traffic, proximity to freight clusters, and proximity to regional freight terminals[1]
- Heavy vehicles currently account for approximately **4% of all traffic on Highway 10.** It is likely that most of these vehicles are involved in freight operations except for school buses, transit buses, etc. Several freight generators exist in the City of Ramsey. The percentage of heavy commercial trucks on north-south intersecting roadways with Highway 10 is higher than average. There is an existing weigh station called Daytonport located just east of Alpine Drive that can weigh trucks traveling either direction on Highway 10. Daytonport weigh station operates Monday through Friday.
- **Freight by Rail** – BNSF parallels the north side of Highway 10 in some locations less than 1/8 of a mile off the highway. This is the busiest segment of rail in state with 57-81 freight trains per day at speeds up to 79 mph and an average train length of 2.6 miles. The number of trains fluctuates depending largely upon oil production in North Dakota. As shown in *Figure 13* three out of four of the railroad crossings within Ramsey are at-grade.
- Although trains move through the study area at high speeds, the frequency of trains is high and trains block the connecting county highway and local roadways for approximately two to three hours per day in Ramsey. In the PM peak hour, traffic along both northbound

[1] Regional Truck Highway Corridor Study, May 2017

Ramsey Blvd and Sunfish Lake Blvd queues onto Highway 10 when trains are present. In addition, southbound Sunfish Lake Blvd queues extend 300 feet nearly reaching McKinley Street when trains are present.

- According to the MnDOT Rail Safety and Coordination Office, the Sunfish Lake Blvd and Ramsey Blvd at-grade rail crossings are in the top tier of statewide locations currently identified for grade separation but are currently unfunded. They were both identified in a legislative directed study in 2014 that looked at crude by rail routes as they pass through heavy population areas.
- **Transit** – Metro Transit has three bus routes serving the area. Routes 850 and the 852 Express serve Anoka and Coon Rapids while route 887 Express serves St. Cloud by connecting to the Northstar train at several stops and downtown Minneapolis by bus. The Northstar train, route 888, runs along the BNSF rail line thru Ramsey and Anoka towards Minneapolis. There are 12 trains per day Monday-Friday as well as a few weekend trains which carry approximately 150,000 riders per quarter. Two to three commuter trains run thru the project area during the peak hours. Special event Northstar trains such as for Twins and Vikings games in Minneapolis increase the number of trains through the corridor to coincide with those game times. The Empire Builder Amtrak line also runs along these tracks two times per day.
- **Future Rail (Transit) Considerations** – According to BNSF, the line has additional capacity and has run 70-80+ freight trains per day in the past. The main capacity constriction along this segment is primarily caused by the Northstar train schedule. The only potential system expansion in the area would be to add a second mainline between Big Lake and Becker, which could increase the number of trains per day. However, this is anticipated to be funded mostly by Metro Transit as it would then allow them to service the St. Cloud area. Additionally, any expansion of Northstar would also potentially increase the number of Northstar trains per day through the area.

G. Bicycle and Pedestrian

The following summarizes bicycle and pedestrian facilities and needs within the study area:

- As shown in *Figure 14* the Mississippi Regional Trail and local trails provide a continuous connection along the south side of Highway 10. There are limited pedestrian and bicycle facilities on the north side of Highway 10.
- The Central Anoka Regional Trail follows much of Bunker Lake Boulevard to the north of the highway corridor.
- The project area is within an Regional Bicycle Transportation Network (RBTN) – Tier 1 Priority Corridor which are identified by the Metropolitan Council as the highest priority for regional transportation planning and investment.
- Existing north-south crossings, of Highway 10, are dedicated at-grade on Ramsey and Sunfish Lake Boulevards. See Relevant Projects (pg. 6) for more detail on the planned pedestrian bridge between the Northstar Transit Station and the regional park.
- The planned Mississippi Skyway will connect the existing skyway at the Northstar Rail Station (north) over Highway 10 to the MRT and the regional park (south).
- The City of Ramsey has prioritized important trail connections around the "Circle of Ramsey" connecting the system of community parks. The closest trail in the "Circle" to the project area is along Bunker Lake Blvd. A small connection crosses Highway 10 on the

western edge of "The Draw". The county recently realigned the Central Anoka County Regional Trail to utilize the future Mississippi Skyway.

- There do not appear to be any visual cues for drivers as to the presence of pedestrians at Highway 10 intersections except for the marked zebra crosswalks. There are signs for pedestrians at some intersections that say do not cross, but nothing to warn a motorist in advance of a pedestrian crossing.
- Not all pedestrian crossings are ADA compliant.
- The right turn islands at Sunfish Lake Blvd, and Ramsey Blvd may not be pedestrian friendly.

Impacts to pedestrian and bicycle facilities will be considered during the development of corridor improvements.

VII. Summary of Issues

The following summarizes key findings from the existing and no-build analysis. This summary will serve as the framework for the project's purpose and need and will be used as foundation to establish project goals and objectives and identify and evaluate improvement alternatives.

- Highway 10 is a principal arterial that provides a significant transportation connection for the region. For instance, Highway 10 is an important commuting route for portions of Anoka, Sherburne and Wright County residents passing through the segment in Ramsey daily without stopping. In addition, Highway 10 plays a broader regional role providing a connection from the Twin Cities Metro Area to St. Cloud and northern Minnesota. Because of this connection, the demands on Highway 10 exceed traditional weekday peak hour travel and include weekends during the summer/fall tourism season as well. Highway 10 in Ramsey has numerous public and private accesses that cumulatively degrade the safety and performance of the corridor. Overall, the capacity and mobility demands of the Highway 10 corridor are underserved and the study area will have multiple areas with failing operations as soon as 2025 without improvements. This inhibits both local and regional mobility.
- Safety concerns exist along Highway 10 with high numbers of crashes, including five fatal crashes, occurring on the corridor. Crash trends are anticipated to increase without improvements.
- Highway 10 is an important rail corridor serving freight, transit and a total of 72 trains per day. Heavy rail traffic inhibits the efficient movement of people and goods across the rail.
- Pedestrian and bicycle movement is difficult along and across Highway 10 and the railroad due to lack of facilities and designated crossing locations.
- The Highway 10 corridor includes a wide range of interdependent land uses including a primary business corridor for the City. Strategic and responsible growth is necessary to align land use with a supporting transportation network and to continue to promote economic development.

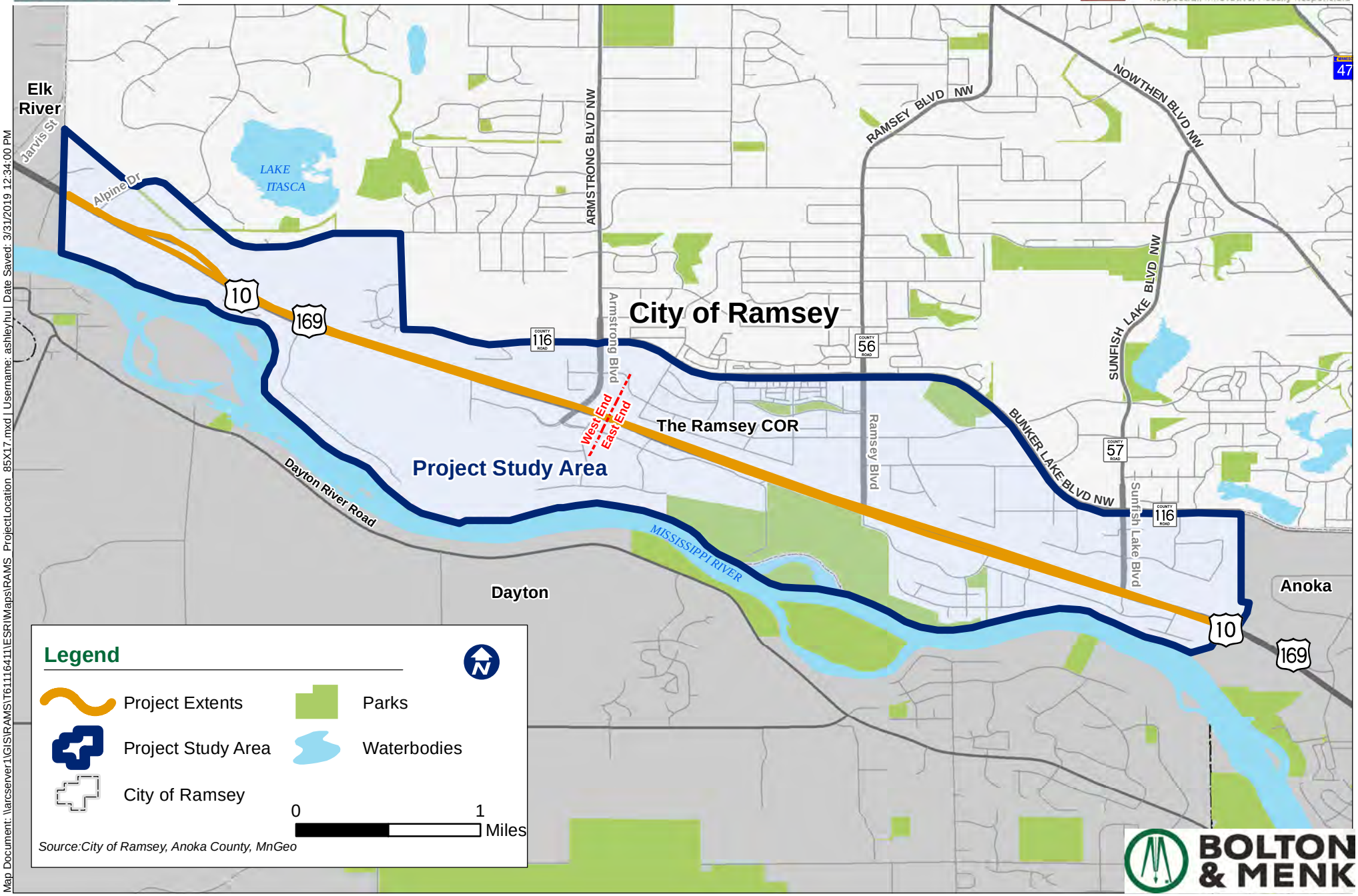
Appendix A: Existing Conditions Figures

Ramsey Gateway Highway 10 Project

City of Ramsey, Minnesota

Project Study Area

July 2018



City of RAMSEY

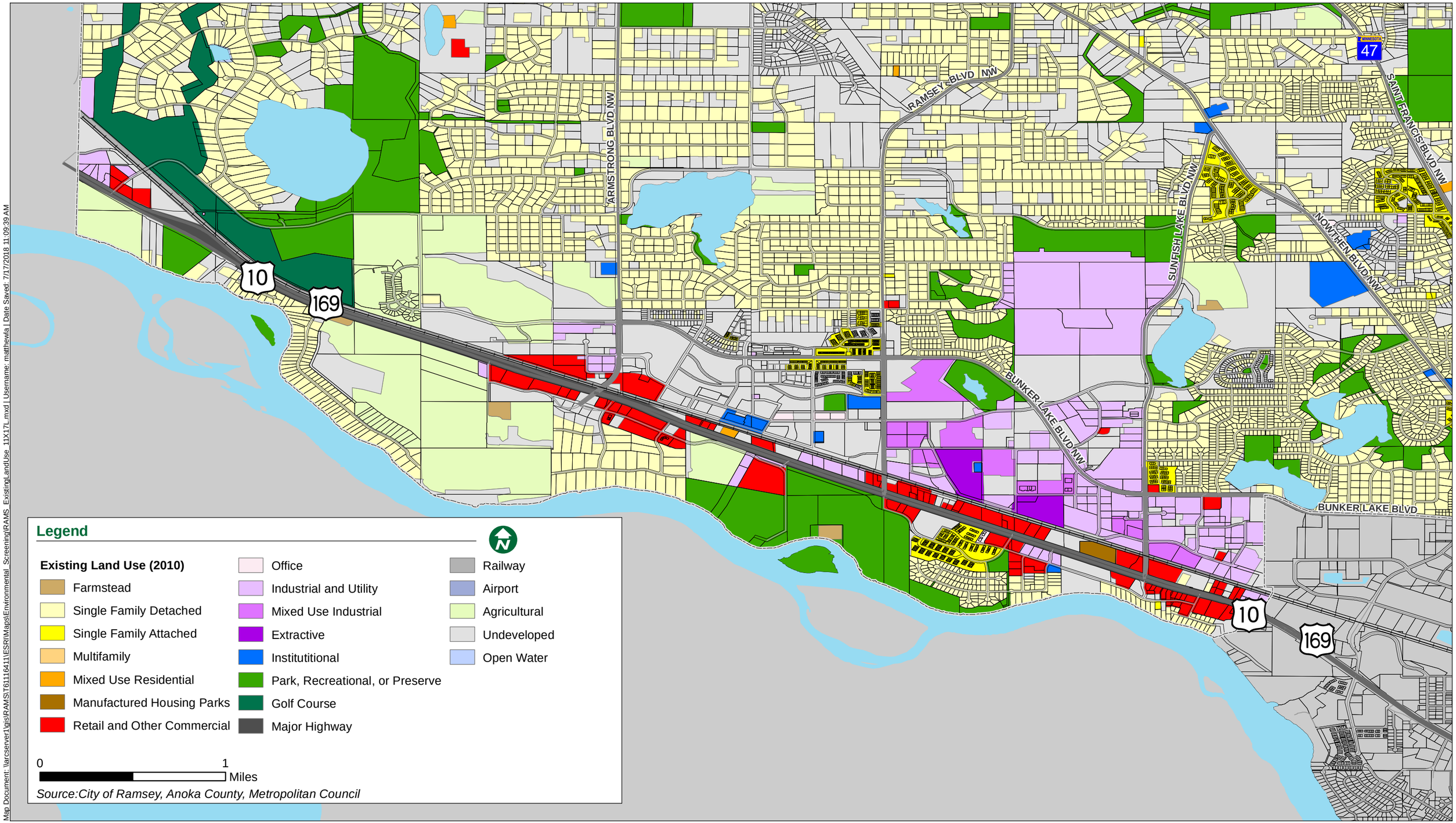
US Highway 10

City of Ramsey, Minnesota

Figure 3 - Existing Land Use

July 2018

BOLTON & MENK



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City of RAMSEY

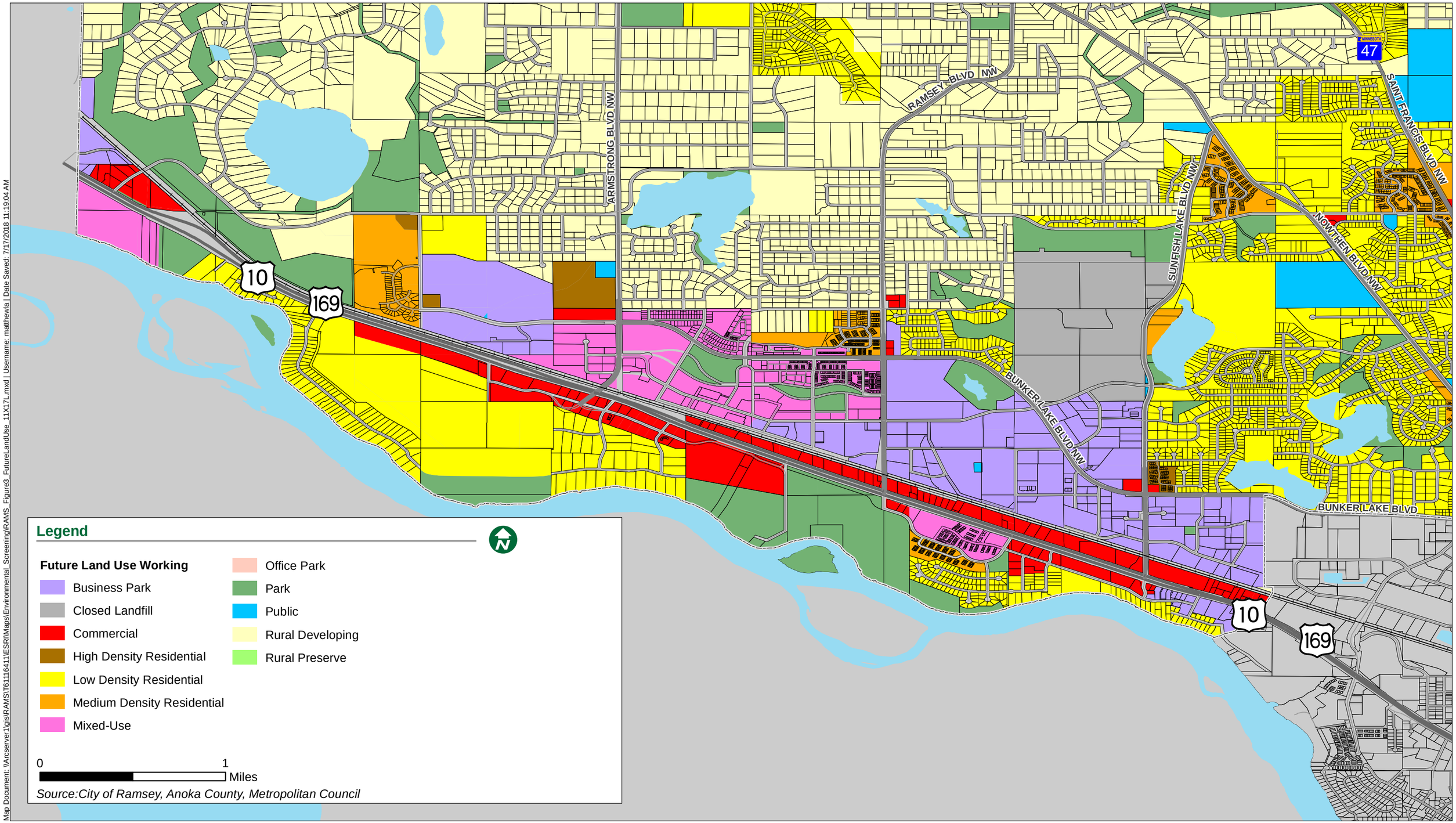
US Highway 10

City of Ramsey, Minnesota

Figure 4 - Future Land Use

July 2018

BOLTON & MENK



Map Document: \\Arcserver1\gis\RAMS\T6711\6411\ESRIMaps\Environmental_Screening\RAMS_Figure3_FutureLandUse_11X17L.mxd | Username: matthewla | Date Saved: 7/17/2018 11:19:04 AM

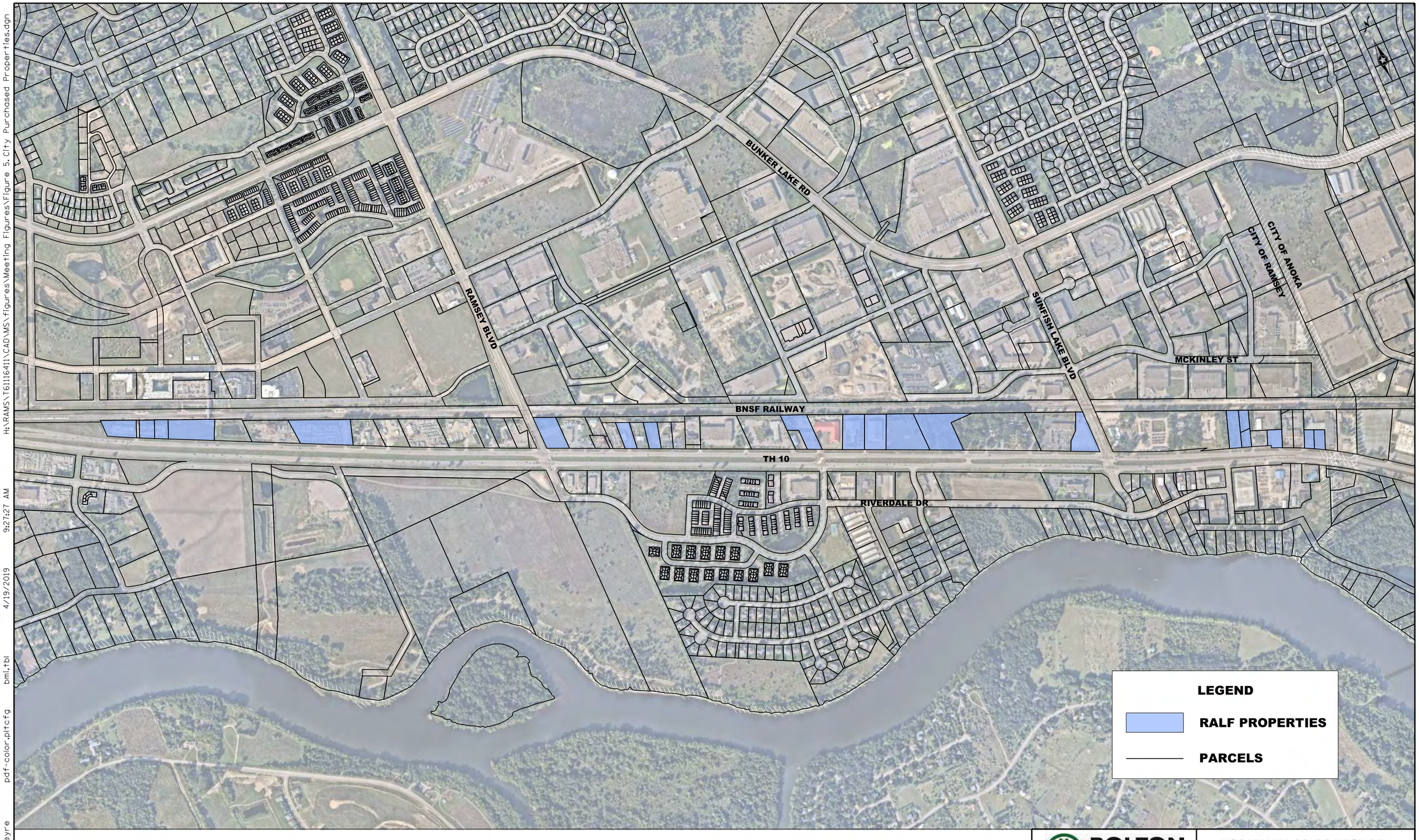


FIGURE 5. CITY PURCHASED PROPERTIES

BOLTON & MENK

HIGHWAY 10 CORRIDOR IMPROVEMENTS

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City of RAMSEY

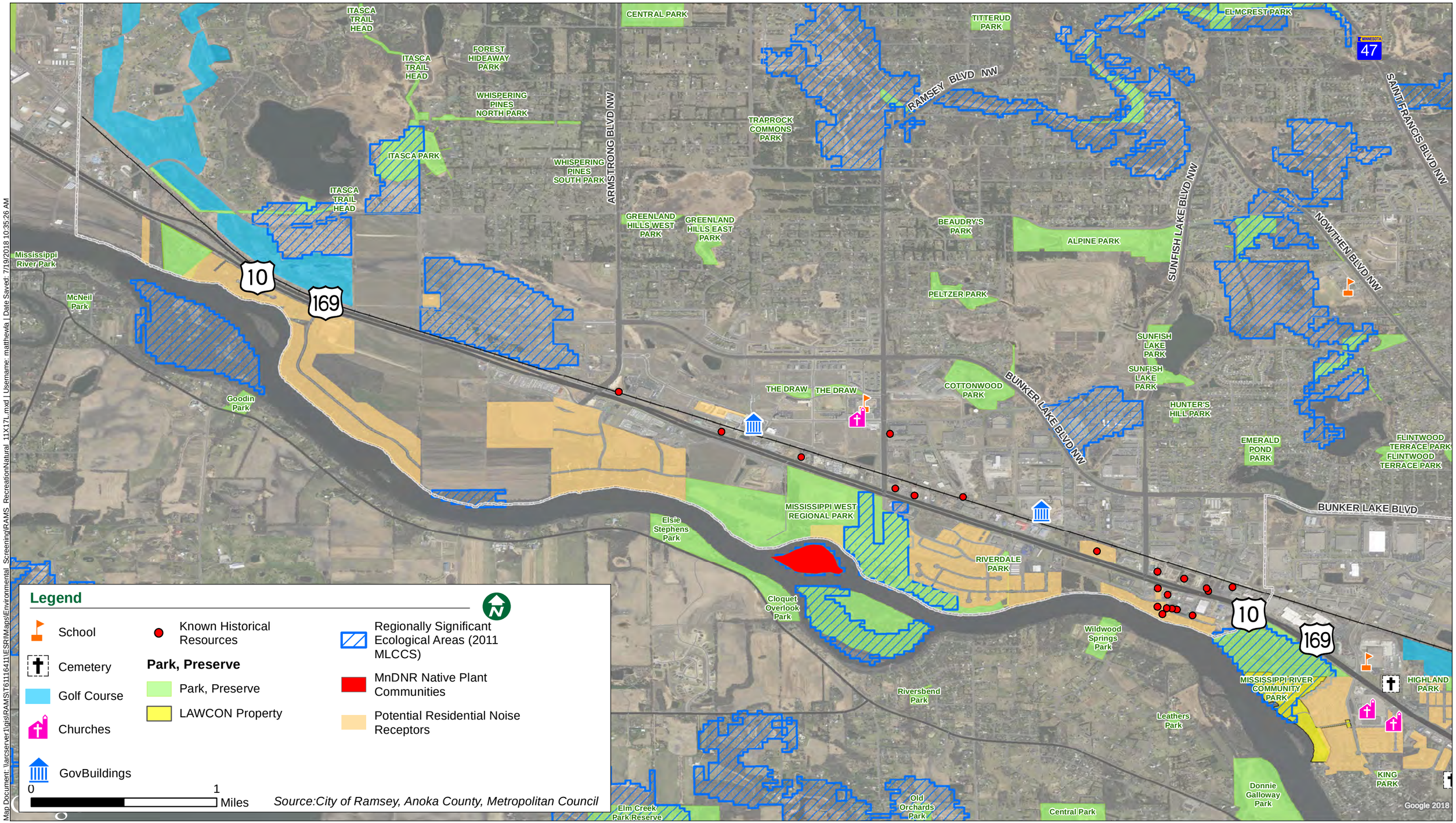
US Highway 10

City of Ramsey, Minnesota

Figure 6 - Recreation, Natural, and Historical Areas

July 2018

BOLTON & MENK



Legend

- School
- Cemetery
- Golf Course
- Churches
- GovBuildings
- Known Historical Resources
- **Park, Preserve**
- Park, Preserve
- LAWCON Property
- Regionally Significant Ecological Areas (2011 MLCCS)
- MnDNR Native Plant Communities
- Potential Residential Noise Receptors

0 1 Miles

Source:City of Ramsey, Anoka County, Metropolitan Council

Map Document: \\arcserver1\gis\RAMS\T6111641\ESRI\Maps\Environmental_Screening\RAMS_RecreationNatural_11X17L.mxd | Username: matthewla | Date Saved: 7/19/2018 10:35:26 AM

City of Ramsey

US Highway 10

City of Ramsey, Minnesota

Figure 7 - Water Resources

July 2018

BOLTON & MENK

Information

*** Note:** The National Parks Service (NPS) designated a 72 mile stretch of land adjacent to the Mississippi River as the Mississippi National River and Recreation Area (MNRRA). The boundaries of the Mississippi River Critical Corridor Area (MRCCA) and the MNRRA are the same.

Legend

- National Wetlands Inventory (NWI)
- Water Body

FEMA Flood Zones

- 100-Year Floodplain
- 500-Year Floodplain

Wild and Scenic River District

- State Recreational River District

Mississippi River Corridor Critical Area (MRCCA)*

- Critical Area - Rural Open
- Critical Area - Urban
- City of Ramsey

0 1 Miles

Source:City of Ramsey, Anoka County, MnGeo, MnDNR, NPS, FEMA, Ducks Unlimited

Google

Google 2018

Map Document: \\Arcserver1\gis\RAMS\T611164111ESRI\Maps\Environmental_Screening\RAMS_Water Resources_11X17L.mxd | Username: matthewk | Date Saved: 7/27/2018 2:36:55 PM

City of RAMSEY

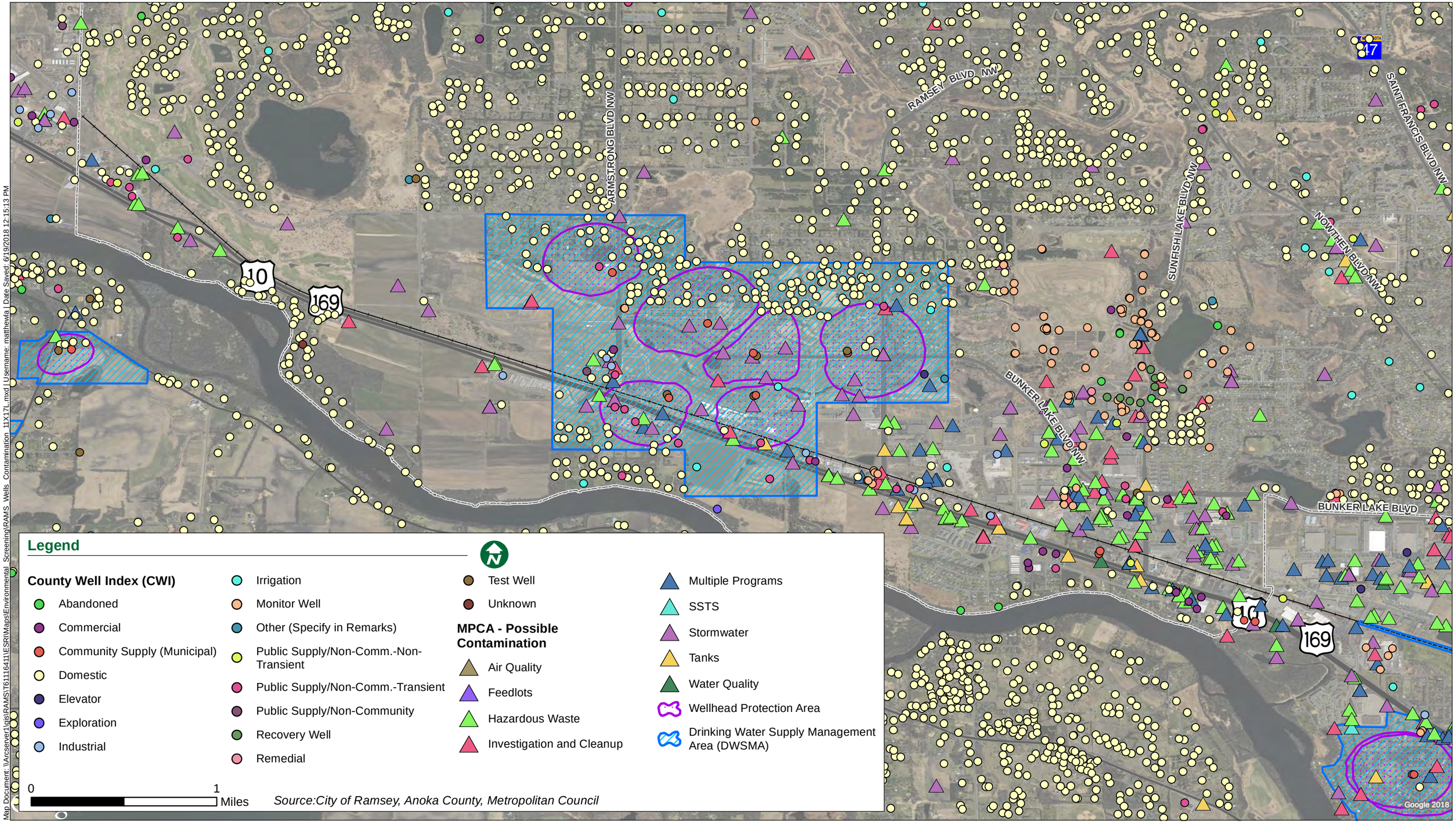
US Highway 10

City of Ramsey, Minnesota

Figure 8 -Wells and Potentially Contaminated Sites

June 2018

BOLTON & MENK



Legend

County Well Index (CWI)

- Abandoned
- Commercial
- Community Supply (Municipal)
- Domestic
- Elevator
- Exploration
- Industrial
- Irrigation
- Monitor Well
- Other (Specify in Remarks)
- Public Supply/Non-Comm.-Non-Transient
- Public Supply/Non-Comm.-Transient
- Public Supply/Non-Community
- Recovery Well
- Remedial
- Test Well
- Unknown

MPCA - Possible Contamination

- Air Quality
- Feedlots
- Hazardous Waste
- Investigation and Cleanup
- Multiple Programs
- SSTS
- Stormwater
- Tanks
- Water Quality
- Wellhead Protection Area
- Drinking Water Supply Management Area (DWSMA)

0 1 Miles

Source:City of Ramsey, Anoka County, Metropolitan Council

Map Document: \\Arcserver1\gis\RAMS\T\611116411\ESRI\Maps\Environmental Screening\RAMS_Wells_Contamination_11X17L.mxd | Username: matthewla | Date Saved: 6/19/2018 12:15:13 PM

City of RAMSEY

Highway 10 Corridor Improvements

Figure 9 - Safety Analysis (2013-2017)

August 2018

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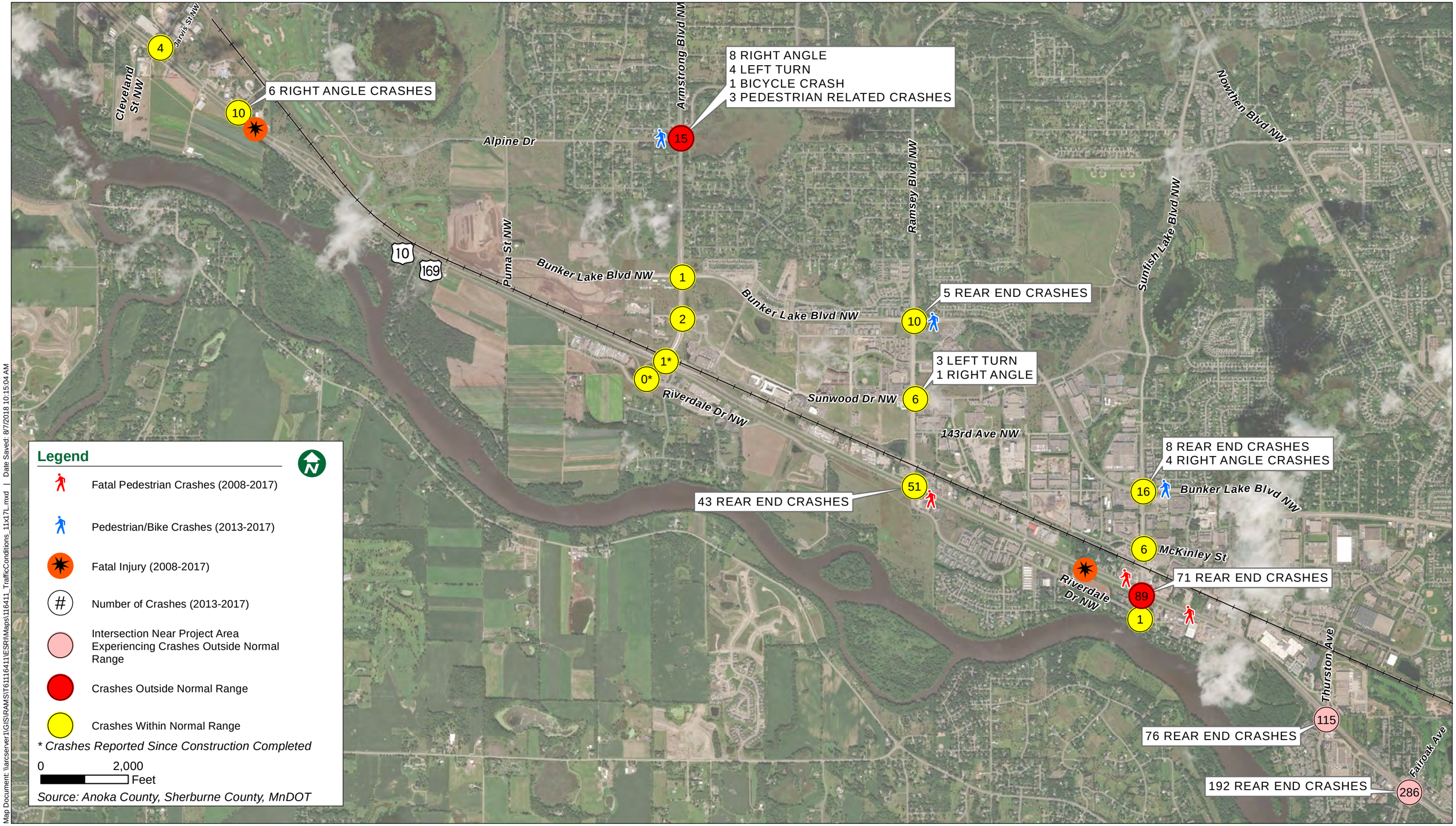
Real People. Real Solutions.



Legend

- Fatal Pedestrian Crashes (2008-2017)
- Pedestrian/Bike Crashes (2013-2017)
- Fatal Injury (2008-2017)
- Number of Crashes (2013-2017)
- Intersection Near Project Area Experiencing Crashes Outside Normal Range
- Crashes Outside Normal Range
- Crashes Within Normal Range

** Crashes Reported Since Construction Completed*

0 2,000 Feet

Source: Anoka County, Sherburne County, MnDOT

City of RAMSEY

Highway 10 Corridor Improvements

Figure 10 - Existing (2018) Turning Movement Counts

August 2018

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Real People. Real Solutions.

Legend

Existing Turning Movement Counts

AM (PM)

0 2,400 Feet

Source: Anoka County

Map Document: \\arcserver1\gis\RAMS\ST61116411\ESRI\Maps\Existing.mxd | Date Saved: 8/7/2018 11:11:52 AM

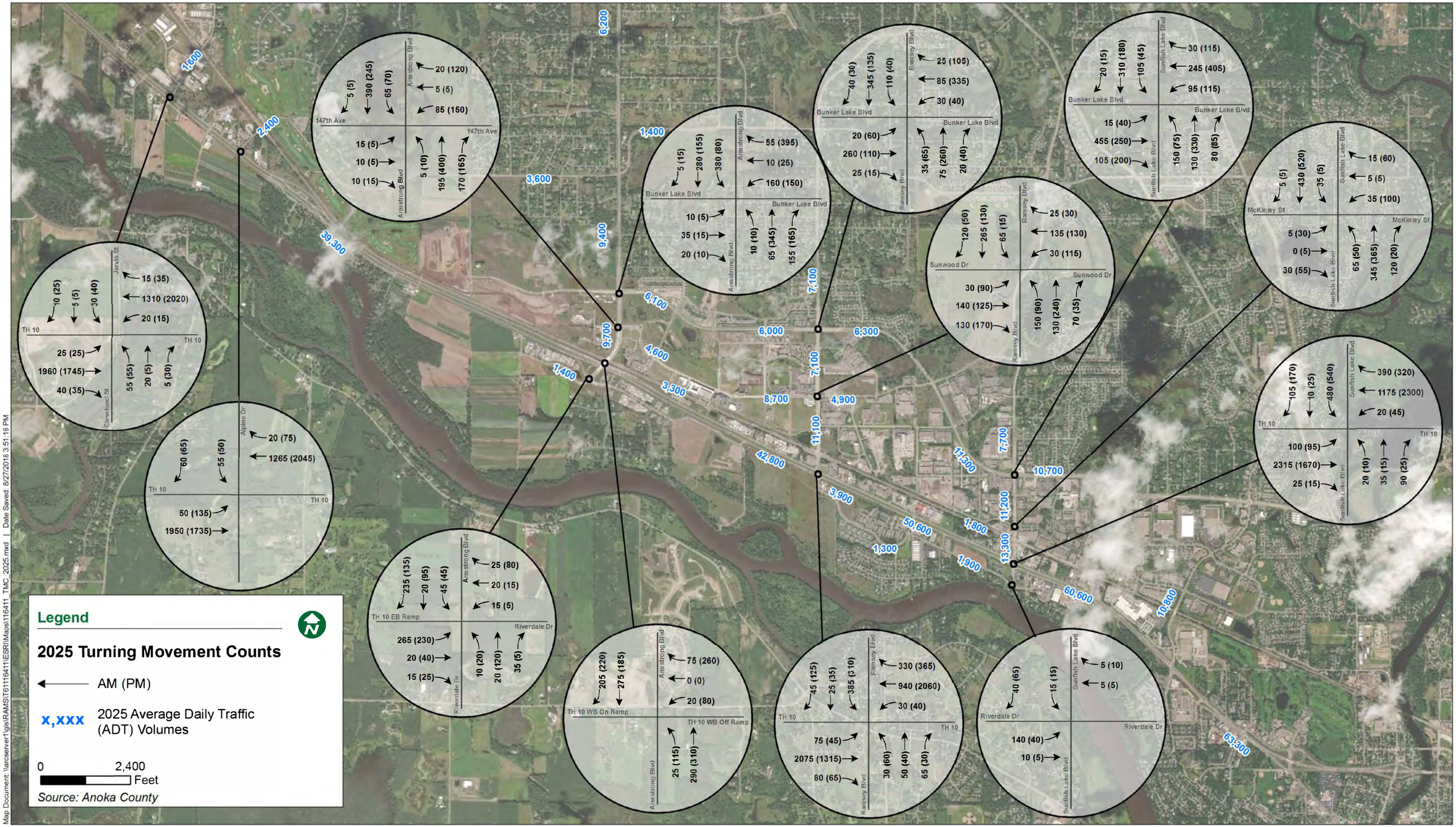
City of RAMSEY

Highway 10 Corridor Improvements

Figure 11 - 2025 Turning Movement Counts

August 2018

BOLTON & MENK
Real People. Real Solutions.



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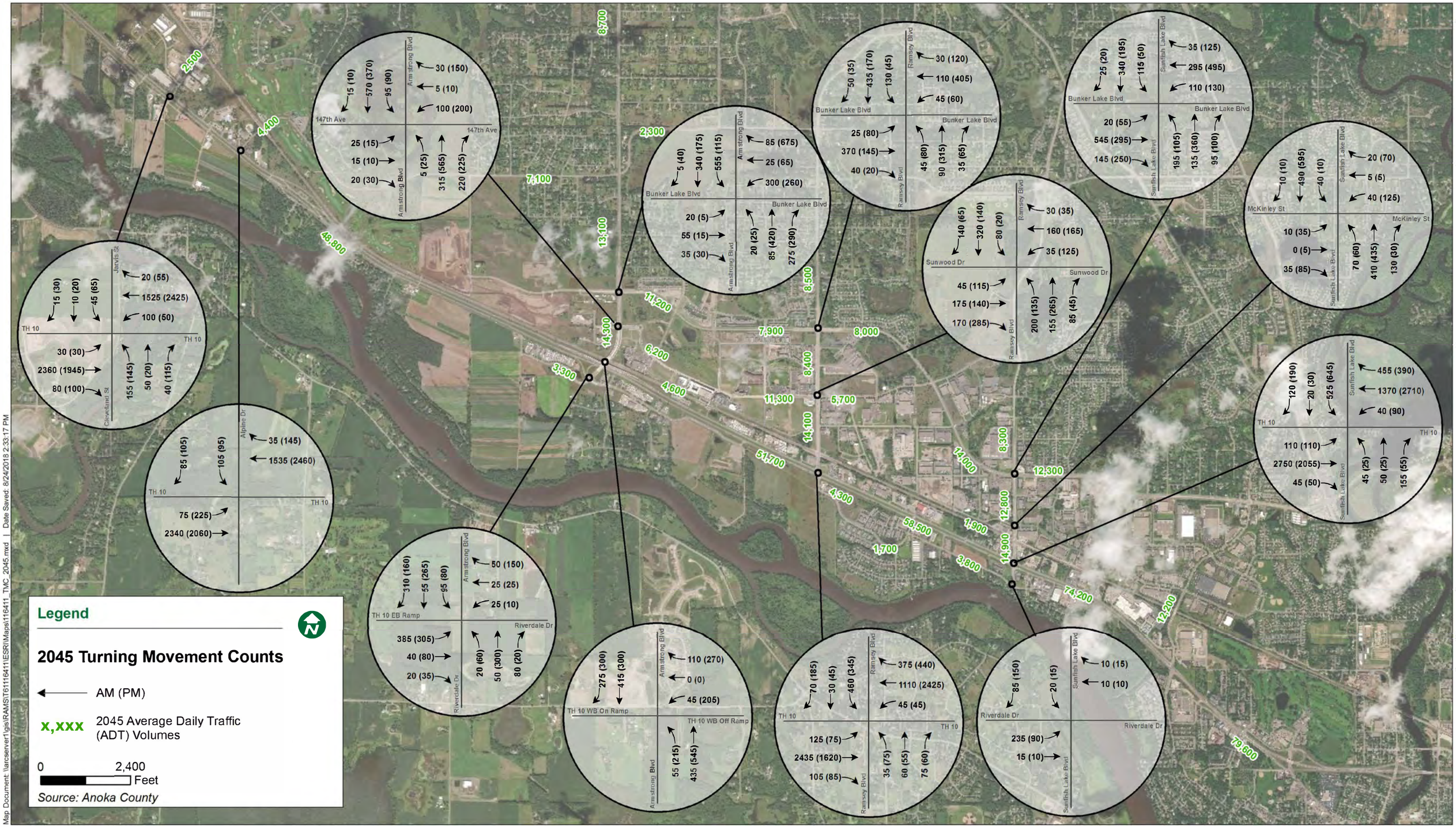
City of RAMSEY

Highway 10 Corridor Improvements

Figure 12 - 2045 Turning Movement Counts

August 2018

BOLTON & MENK
Real People. Real Solutions.



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City of RAMSEY

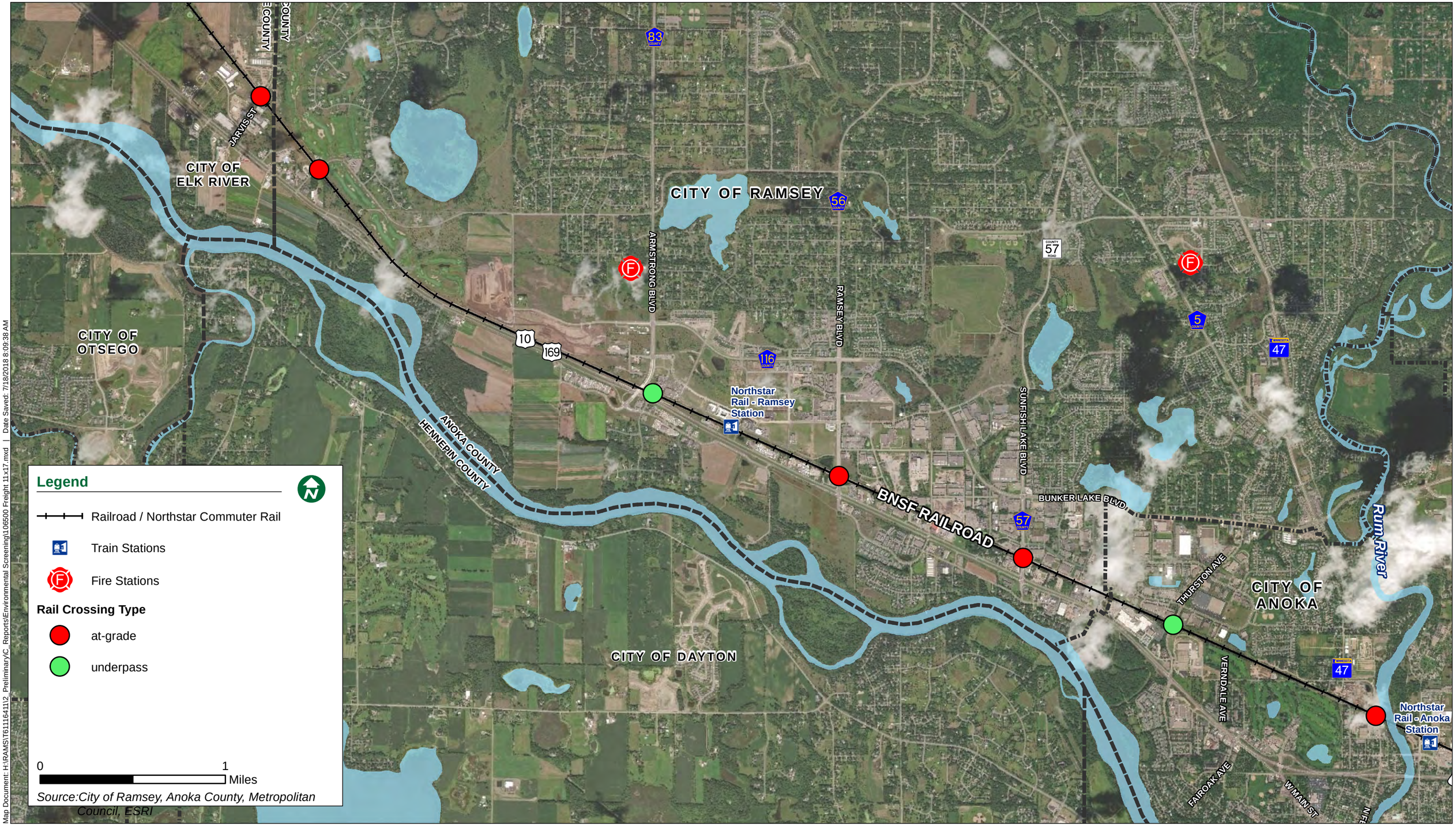
US Highway 10

City of Ramsey, Minnesota

Figure 13 - Freight and Transit by Rail

July 2018

BOLTON & MENK
Real People. Real Solutions.



Legend

- Railroad / Northstar Commuter Rail
- Train Stations
- Fire Stations

Rail Crossing Type

- at-grade
- underpass

0 1 Miles

Source:City of Ramsey, Anoka County, Metropolitan Council, ESRI

City of RAMSEY

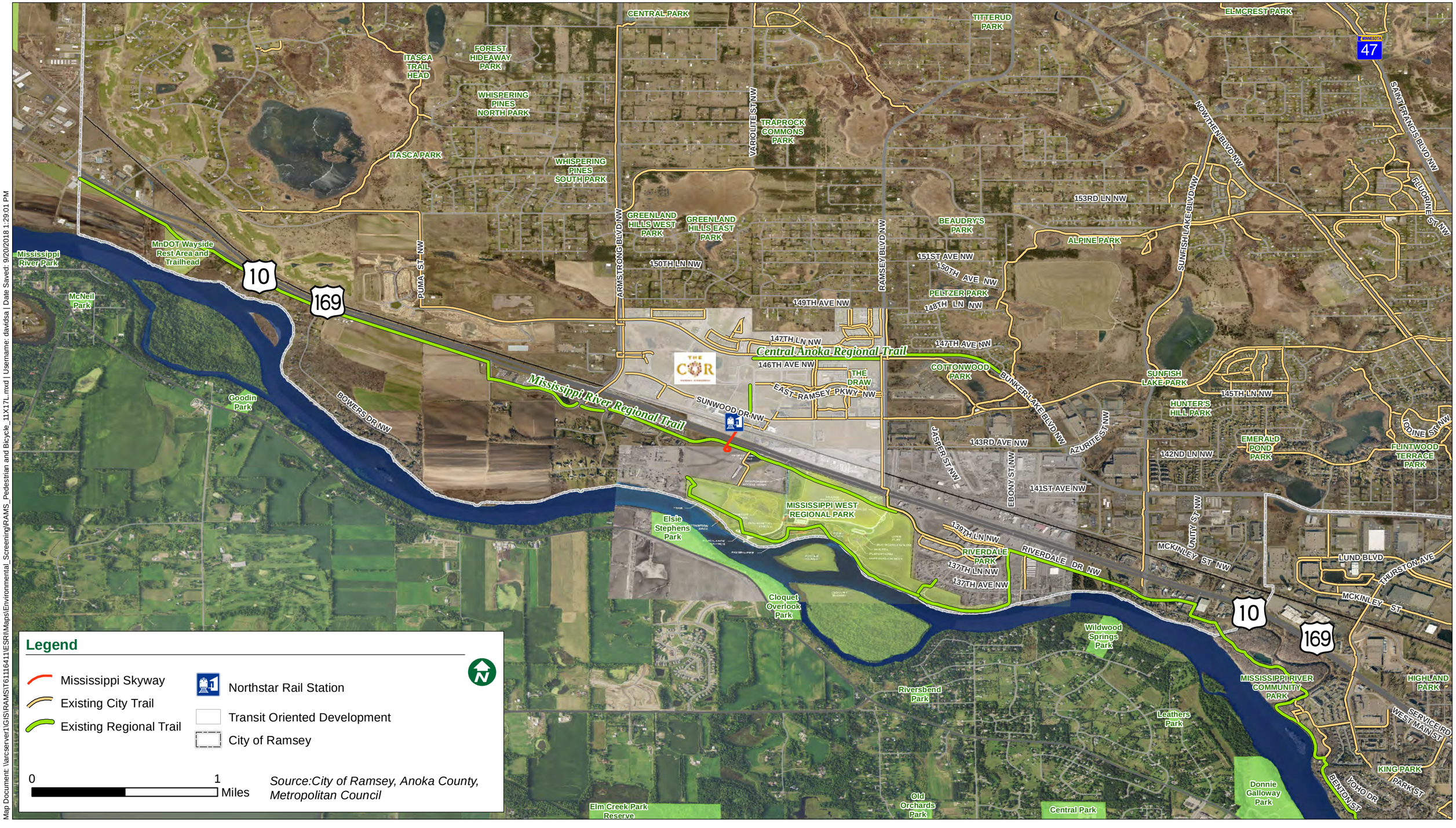
US Highway 10

City of Ramsey, Minnesota

Figure 5 - Pedestrian and Bicycle Facilities

September 2018

BOLTON & MENK



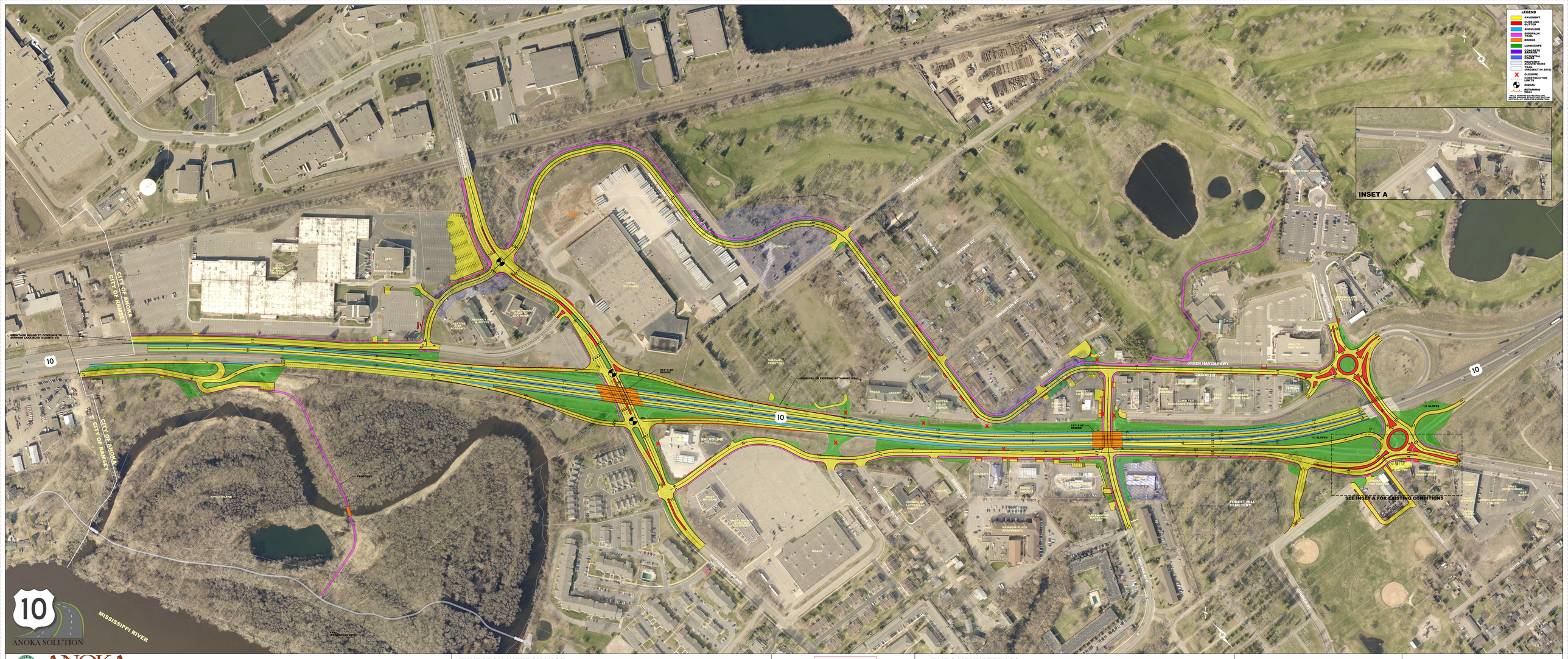
Legend

- Mississippi Skyway
- Existing City Trail
- Existing Regional Trail
- Northstar Rail Station
- Transit Oriented Development
- City of Ramsey

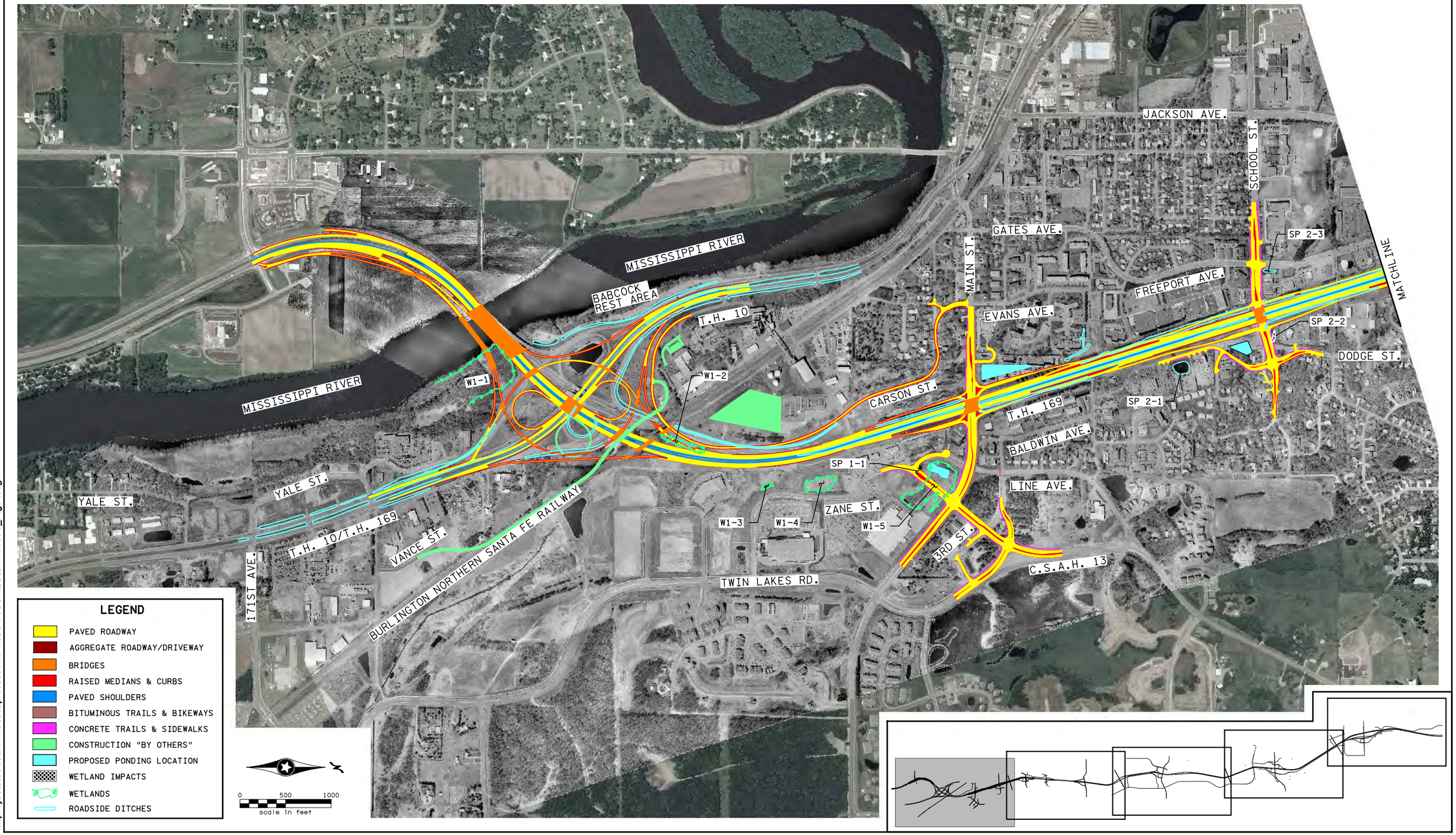
0 1 Miles

Source:City of Ramsey, Anoka County, Metropolitan Council

Appendix B: Relevant Developments



ANOKA REAL CLASSIC	**THURSTON INTERCHANGE PREFERRED ALTERNATIVE**	LOWER THURSTON AVE 2' AND RAISE TH10 20' 3200' OF TH 10 RECONSTRUCTION	**DRAFT**	**FAIROAK UNDERPASS PREFERRED ALTERNATIVE**	LOWER FAIROAK AVE 8' AND RAISE TH10 14' 2900' OF TH 10 RECONSTRUCTION	**ANOKA SOLUTION**	MAY 2015 CITY OF ANOKA



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PROPOSED IMPROVEMENTS / WETLAND IMPACTS

ENVIRONMENTAL ASSESSMENT
T.H. 169 - SP 7106-73

Figure 4A

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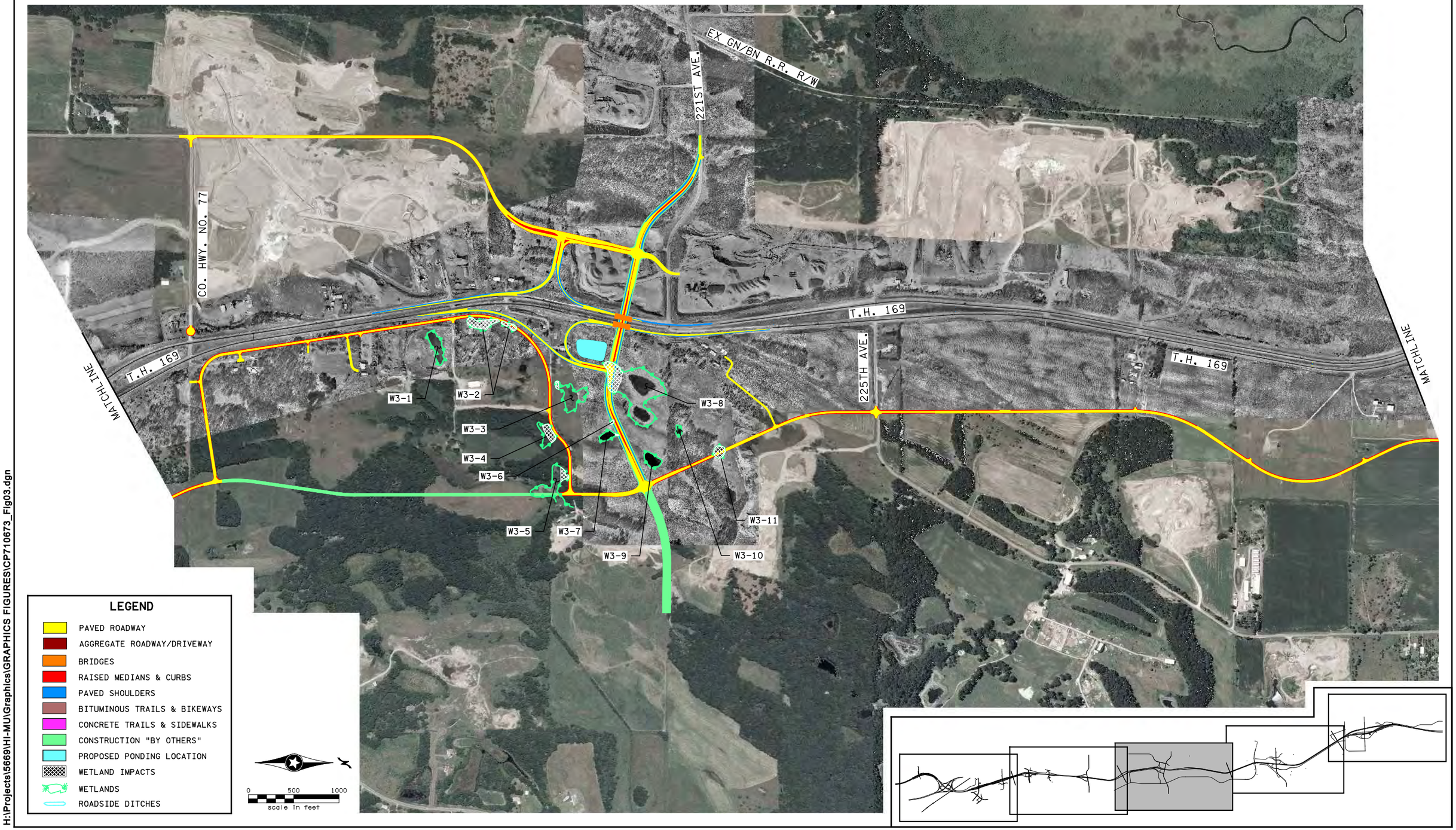
PROPOSED IMPROVEMENTS / WETLAND IMPACTS

ENVIRONMENTAL ASSESSMENT
T.H. 169 - SP 7106-73

Figure 4B



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PROPOSED IMPROVEMENTS / WETLAND IMPACTS

ENVIRONMENTAL ASSESSMENT
T.H. 169 - SP 7106-73

Figure 4C

Regional Mississippi Skyway Multiuse Trail Bridge

City of RAMSEY

THE COR

RAMSEY, MINNESOTA

DEVELOPMENT STATUS

- EXISTING DEVELOPMENT
- PROPOSED DEVELOPMENT
- ACTIVE DEALS
- UNDER CONTRACT
- COMPLETED

ACCESS

- EXISTING SIGNALIZED INTERSECTION
- FUTURE SIGNALIZED INTERSECTION
- F — FULL INTERSECTION
- 3/4 — NO LEFT OUTBOUND MOVEMENTS
- P — PARKING RAMP

TRAFFIC INFORMATION

ADT INFORMATION TAKEN FROM 2009 ACTUAL COUNTS AND 2030 PROJECTED VOLUMES

NORTH 0 300 600

LANDFORM
From Site to Finish

DEVELOPMENT PLAN 6.0

05.15.2012

Appendix C: Existing Traffic Conditions Memo

BOLTON & MENK
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

Table 1. Distance Between Primary Intersections

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

*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 ½ 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.

Table 2. Distance between Secondary Intersections (Eastbound)

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 – 153rd Ave (Full Access)	0.20	FAIL
153rd 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

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

Table 3. Distance between Secondary Intersections (Westbound)

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 - 153rd Ave (Full Access)	0.55	PASS
153rd Ave (Full Access) - Alpine Dr	0.20	FAIL
Alpine Dr - Adams St (RIRO)	0.20	FAIL
Adams St (RIRO) - Jarvis St	0.25	FAIL

*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), ¾ 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.

Table 4. Secondary Intersection Gap Analysis

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

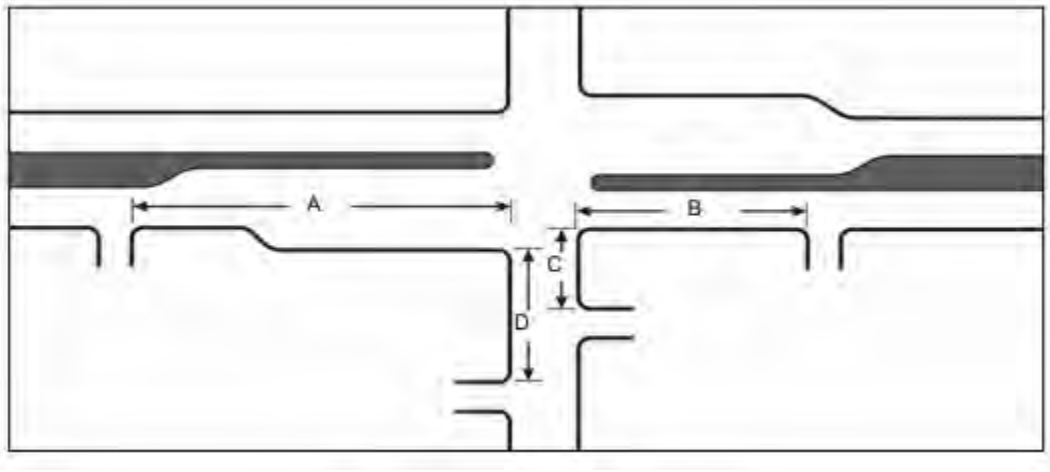
*2013 Traffic Volumes (vehicle/hour)

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.

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

Direction	Name	Distance	A	B	C	D
EB	Jarvis St	Required	650	645	75	75
		Actual	525	285	85	50
	Adams St	Required	650	645	75	75
		Actual	940	100	70	575
	153rd Ave (Residential Access)	Required	650	645	75	75
		Actual	1900	1855	-	-
	Beatty St	Required	650	645	75	75
		Actual	475	685	225	-
	Bowers Dr	Required	650	645	75	75
		Actual	265	435	445	120
	Field Access	Required	650	645	75	75
		Actual	185	2990	-	-
	Armstrong EB Ramp	Required	650	1110	225	225
		Actual	4450	4170	715	715
	Ramsey Blvd	Required	650	570	225	225
		Actual	2025	2760	225	1565
	Feldspar St	Required	650	570	75	75
		Actual	2705	865	200	345
	Dolomite St	Required	650	570	75	75
		Actual	860	570	375	375
	Sunfish Lake Blvd	Required	650	570	225	225
		Actual	650	400	225	225
	Tungsten St	Required	650	570	75	75
		Actual	290	230	65	85
	Business Access (between Tungsten St & East City Limits)	Required	650	570	75	75
		Actual	310	150	-	-

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

Direction	Name	Distance	A	B	C	D
WB	Business Access (between Tungsten St & East City Limits)	Required	650	570	75	75
		Actual	280	185	90	-
	Sunfish Lake Blvd	Required	650	570	225	75
		Actual	245	465	395	275
	McKinley St	Required	650	570	75	75
		Actual	170	995	-	-
	Feldspar St	Required	650	570	75	75
		Actual	410	200	-	-
	Ramsey Blvd	Required	650	570	225	75
		Actual	210	455	170	185
	Armstrong WB Ramp	Required	650	645	225	225
		Actual	575	4055	1015	1015
	153rd Ave (Residential Access)	Required	650	645	75	75
		Actual	4920	370	-	-
	Alpine Dr	Required	650	645	125	125
		Actual	590	285	255	205
	Adams St	Required	650	645	75	75
		Actual	135	810	140	365
	Jarvis St	Required	650	645	75	75
		Actual	145	850	250	280

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.

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

Business	Direct Accesses to TH 10	Does business have other accesses?	Total Accesses
Jarvis St to Alpine Dr			
Riverside Farms	1	Yes	3
Alpine Dr to 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 Blvd to Ramsey Blvd			
None			
Ramsey Blvd to Sunfish Lake Blvd			
Comfort Suites	1	Yes	3
Sunfish Lake Blvd to City Limits			
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 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 Blvd			
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

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

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

Table 9. Accesses Between Primary Intersections

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 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 147th 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.

Table 10. Armstrong Blvd at Alpine Dr Crash Type

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

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**.

Table 11. Armstrong Blvd at Alpine Dr Crash Severity

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

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.

Table 12. TH 10 at Sunfish Lake Blvd Crash Type

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

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**.

Table 13. TH 10 at Sunfish Lake Blvd Crash Severity

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

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. 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.

Table 14. TH 10 and Ramsey Blvd Crash Type

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

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**.

Table 15. TH 10 and Ramsey Blvd Crash Severity

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

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.

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

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

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

Crash Severity	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.

Table 18. TH 10 from Armstrong Blvd to the East City Limits Segment Crash Type

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

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 Limits Segment Crash Severity

Crash Severity	**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 non-incapacitating 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.

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

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.

Table 20. Existing (2018) No Build Operational Analysis

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

*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
  - Southbound left and through movements operate with failing LOS
- TH 10 at Ramsey Blvd
  - Northbound, southbound and eastbound left turn movements operate with failing LOS
  - Northbound and southbound through movements operate with failing LOS
  - Average delay is over two minutes per vehicles for the southbound approach
- TH 10 at Sunfish Lake Blvd
  - Northbound, southbound, and westbound left turn movements operate with failing LOS
  - Southbound through movement operate with failing LOS
  - 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
    - 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.
    - 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
    - Northbound through movement operates with failing LOS
    - 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. Highway 10 Eastbound 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 22. Highway 10 Westbound Speeds

Highway 10 Westbound Locations	Average Speed (MPH)	
	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

*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.

Table 23. 2025 No Build Operational Analysis

Location	Peak Hour	Intersection Delay- LOS		Maximum Delay- LOS**		Limiting Movement ***	Max Approach Queue		
							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	C	1347	F	NBL	NBR	675	1000
TH 10 at Alpine St	AM	3	A	29	D	SBL	SBL/R	25	125
Stop Controlled	PM	10	B	147	F	SBL	EBL/SBL	50	275
Armstrong Blvd at Alpine St.	AM	24	C	180	F	WBR	EBR	75	400
Stop Controlled	PM	11	B	25	D	EBL	EBR	25	200
Armstrong Blvd at Bunker Lake Blvd	AM	24	C	49	D	EBL	SBL	125	575
Signalized Intersection	PM	11	B	40	D	EBL/EBT	NBT/SBL	25	125
Armstrong Blvd at 147th St	AM	9	A	30	C	NBL	SBT	25	150
Signalized Intersection	PM	11	B	26	C	EBL	NBT	25	150
WB TH 10 Ramps at Armstrong Blvd	AM	6	A	42	D	WBL	SBR	25	150
Signalized Intersection	PM	4	A	41	D	WBL	WBL	25	200
EB TH 10 Ramps at Armstrong Blvd	AM	3	A	19	C	EBL	EBL	25	175
Stop Controlled	PM	3	A	32	D	EBL	EBL	50	300
Bunker Lake Blvd at Ramsey Blvd	AM	21	C	37	D	WBL	EBT	50	150
Signalized Intersection	PM	23	C	39	D	WBL	WBT	50	225
Sunwood Dr at Ramsey Blvd	AM	23	C	43	D	NBL	NBL	50	425
Signalized Intersection	PM	26	C	45	D	NBL	NBL	25	250
TH 10 at Ramsey Blvd	AM	33	C	480	F	SBT	EBT	150	1050
Signalized Intersection	PM	27	C	120	F	SBL	WBT	100	1300
Bunker Lake Blvd at Sunfish Lake Blvd	AM	29	C	43	D	EBT	EBT	75	450
Signalized Intersection	PM	24	C	39	D	EBT	WBT	50	275
McKinley St. at Sunfish Lake Blvd	AM	3	A	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	C	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	A	10	B	SBL/R	SBL/R	25	75
Stop Controlled	PM	5	A	10	B	SBL	SBL/R	25	150

*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
  - Northbound approach operates with over 24 minutes of delay on average per vehicle
  - Southbound approach operates with over six minutes of delay on average per vehicle
  - Westbound left turn movement operates with a failing LOS
- Alpine Dr at Armstrong Blvd
  - Westbound approach operates with a failing LOS
  - Eastbound left turn movement operates with a failing LOS

- TH 10 at Ramsey Blvd
  - 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
  - Northbound, southbound and westbound left turn movements operate with failing LOS
  - 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.
  - Sunfish Lake Blvd at McKinley St
  - TH 10 at Sunfish Lake Blvd
- TH 10 at Jarvis St
  - Northbound approach operates with over 16 minutes of delay on average per vehicle
  - Southbound approach operates with over two minutes of delay on average per vehicle
  - 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
  - All left turn movements operate with failing LOS
  - 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
  - Eastbound left turn movement operates with failing LOS
- TH 10 at Sunfish Lake Blvd
  - All left turn movements operate with failing LOS
  - Northbound and southbound through movements operate with failing LOS
  - Southbound right movement operates with failing LOS
  - 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
  - Maximum eastbound queues block both turn lanes during both peak hours
  - Maximum westbound queues block both turn lanes during the PM peak hour
- Sunfish Lake Blvd at McKinley St
  - Maximum westbound queues extend past Radium St during the PM peak hour
- TH 10 at Sunfish Lake Blvd
  - 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
  - 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.

Table 24. 2045 No Build Operational Analysis

Location	Peak Hour	Intersection Delay- LOS		Maximum Delay-LOS**		Limiting Movement ***	Max Approach Queue		
							Direction	Average Queue (ft)	Max 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	C	59	E	NBL	SBL	200	775
Signalized Intersection	PM	20	B	57	E	NBL	WBR	75	525
Armstrong Blvd at 147th St	AM	12	B	30	C	EBT	SBT	25	250
Signalized Intersection	PM	15	B	33	C	EBT	WBR	25	200
WB TH 10 Ramps at Armstrong Blvd	AM	14	B	39	D	WBL	SBT/SBR	25	200
Signalized Intersection	PM	17	B	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	C	43	D	WBL	SBT	50	275
Signalized Intersection	PM	23	C	38	D	NBL	WBT	50	200
Sunwood Dr at Ramsey Blvd	AM	37	D	71	E	SBT	NBL	50	400
Signalized Intersection	PM	27	C	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	C	57	E	NBL	EBT	100	550
Signalized Intersection	PM	26	C	37	D	EBT	WBT	75	350
McKinley St. at Sunfish Lake Blvd	AM	4	A	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	A	14	B	SBL/R	SBL/R	25	200

*Delay in seconds per vehicle
**Maximum delay and LOS on any approach and/or movement
***Limiting Movement is the highest delay approach

2045 AM Delay

- The following intersections operate with LOS F during the 2045 AM peak hour:
  - 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
  - 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
  - Northbound approach operates with over 10 minutes of delay on average per vehicle
  - 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
  - All eastbound and northbound movements operate with failing LOS
  - The southbound left and westbound left movements operate with failing LOS
  - 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:
  - 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
  - Eastbound and westbound left turn movements operate with failing LOS
- TH 10 at Alpine Dr
  - Westbound and southbound approaches operate with failing LOS
- TH 10 EB Ramp at Armstrong
  - Eastbound approach operates with over four minutes of delay on average per vehicle

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

2045 Queueing Issues

- TH 10 at Jarvis
  - Queues on all approaches are extensive
  - 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
  - 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
  - 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
  - Maximum northbound through queue blocks turn lanes during the AM peak hour
- Sunfish Lake Blvd at Bunker Lake Blvd
  - Maximum eastbound through queue blocks turn lanes during the AM peak hour
- Sunfish Lake Blvd at McKinley St
  - 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
- 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
  - Jarvis St to Adams St
  - Adams St to Alpine Dr
  - Alpine Drive to 153rd Ave
  - Beatty St to Bowers Dr
  - Bowers Dr to Field Access
  - Feldspar St to Dolomite St (eastbound)
  - Dolomite St to McKinley St (eastbound)
  - McKinley St to Sunfish Lake Blvd
  - Sunfish Lake Blvd to Tungsten St (eastbound)
  - Tungsten St to Business Access (near East City Limits) (eastbound)
  - Business Access (between Tungsten St & East City Limits) to Sunfish Lake Blvd (westbound)
  - 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
  - Jarvis St
  - Adams St

- Alpine Dr
- 153rd Ave
- Beatty St
- Bowers Dr
- Field Access
- Ramsey Blvd
- Feldspar St
- McKinley St
- Sunfish Lake Blvd
- Tungsten St
- 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.

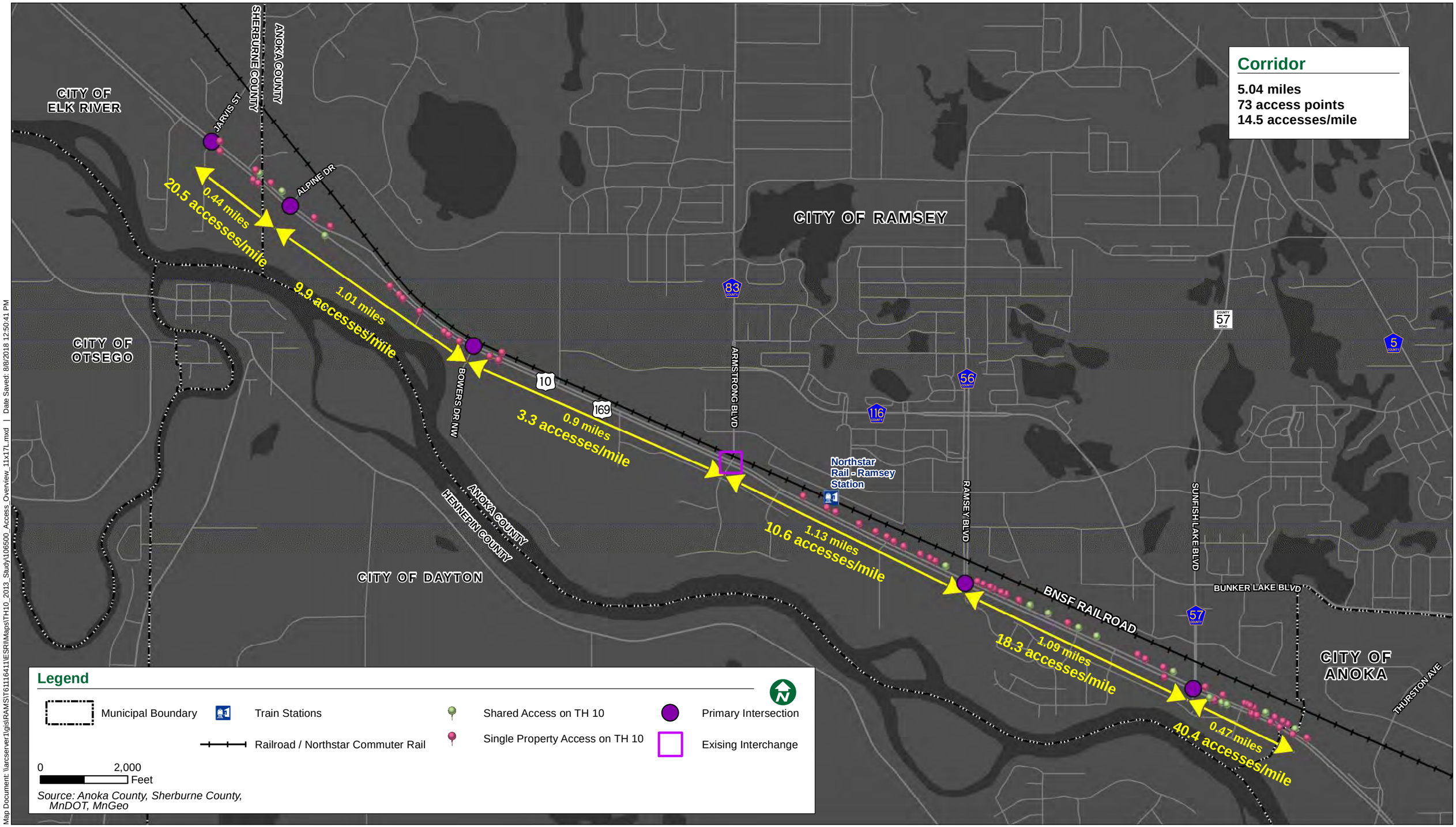
Appendix A

Highway 10 Corridor Improvements

Figure 1. Access Planning Study

August 2018

BOLTON & MENK
Real People. Real Solutions.



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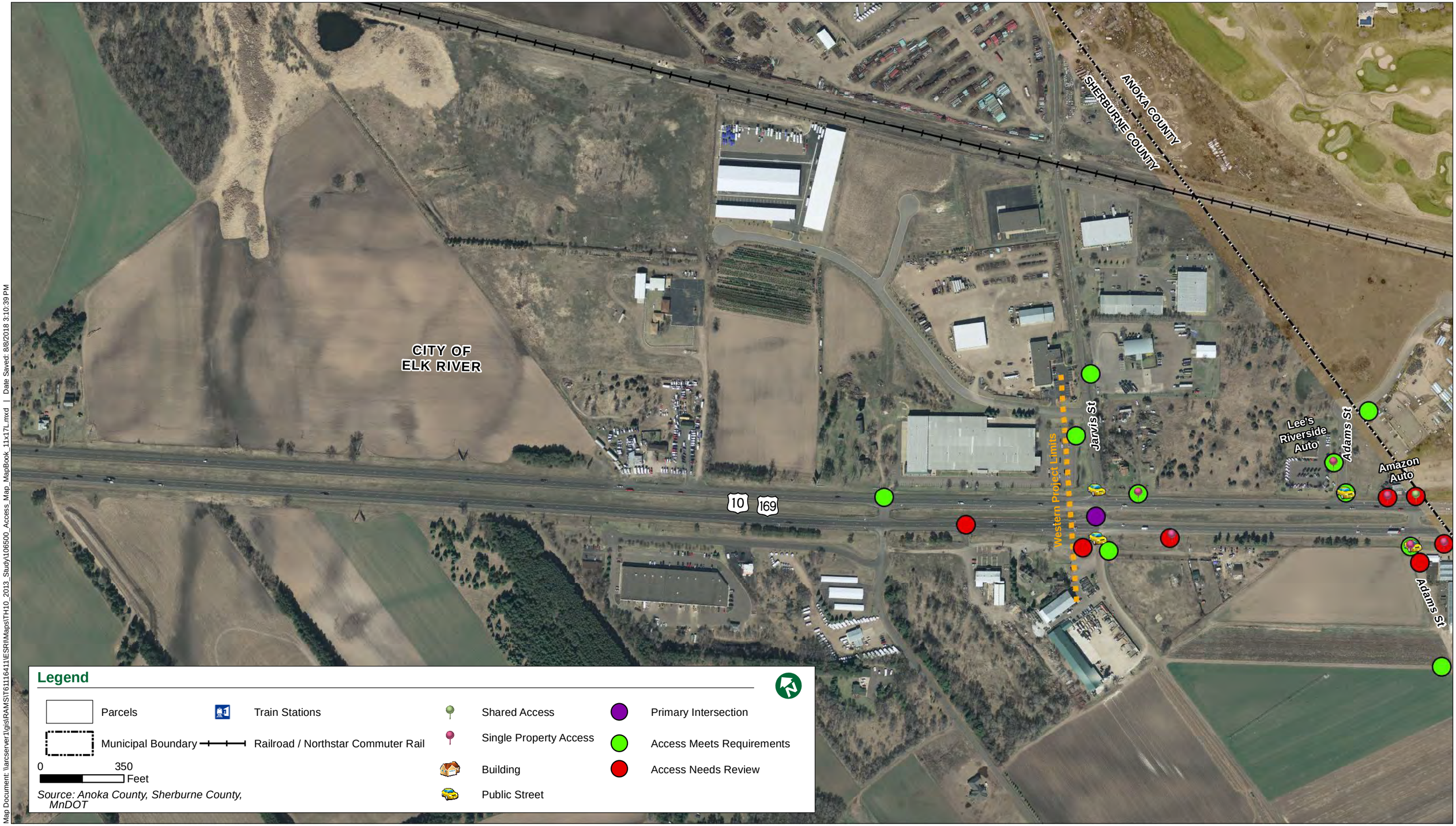
City of RAMSEY

Highway 10 Corridor Improvements

Figure 2A. Access Locations for Properties Adjacent to TH 10

August 2018

BOLTON & MENK
Real People. Real Solutions.



Legend

- Parcels
- Municipal Boundary
- Train Stations
- Railroad / Northstar Commuter Rail
- Shared Access
- Single Property Access
- Building
- Public Street
- Primary Intersection
- Access Meets Requirements
- Access Needs Review

0 350 Feet

Source: Anoka County, Sherburne County, MnDOT

Map Document: \\arcserver1\gis\RAMS\T6111641\ESRI\Maps\TH10_2013_Study\106500_Access_Map_MapBook_11x17L.mxd | Date Saved: 8/8/2018 3:10:39 PM

Highway 10 Corridor Improvements

Figure 2B. Access Locations for Properties Adjacent to TH 10

August 2018

BOLTON & MENK
Real People. Real Solutions.

The Links at Northfork Golf Course
Lee's Riverside Auto
Adams St
Amazon Auto
Top Shelf Tires
Engles Auto
Boiler Makers Local 647
Alpine Dr
Paint & Pallet
Skeeter Boat Center
10
169
153rd St
Weigh Station
Rest Area
Beatty St
Riverside Farms Greenhouse
Adams St

Legend

- Parcels
- Municipal Boundary
- Train Stations
- Railroad / Northstar Commuter Rail
- Shared Access
- Single Property Access
- Building
- Public Street
- Primary Intersection
- Access Meets Requirements
- Access Needs Review

0 350 Feet

Source: Anoka County, Sherburne County, MnDOT

Map Document: \\arcserver1\gis\RAMS\T6111641\ESRI\Maps\TH10_2013_Study\106500_Access_Map_MapBook_11x17L.mxd | Date Saved: 8/8/2018 3:10:39 PM

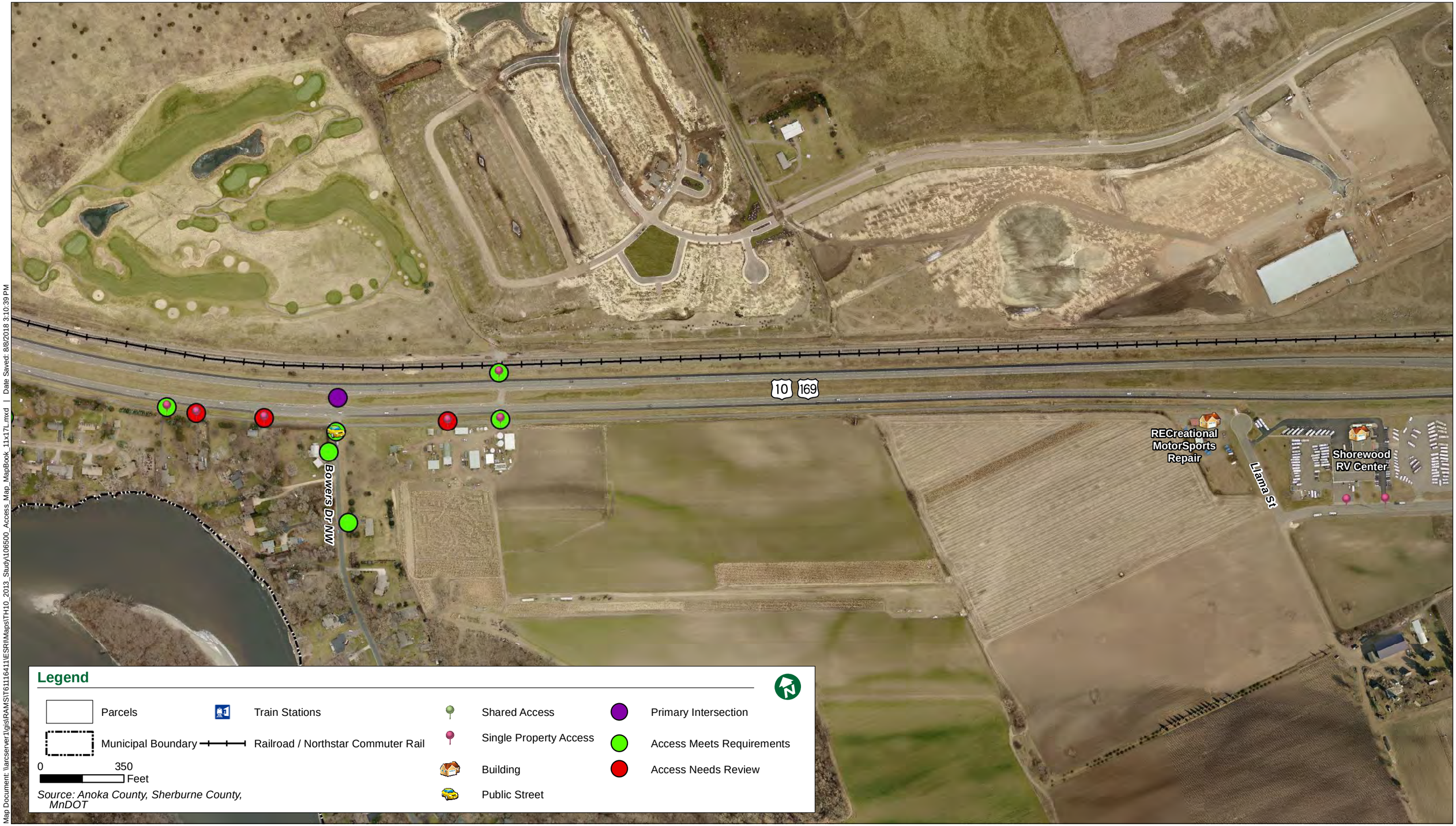
City of RAMSEY

Highway 10 Corridor Improvements

Figure 2C. Access Locations for Properties Adjacent to TH 10

August 2018

BOLTON & MENK
Real People. Real Solutions.



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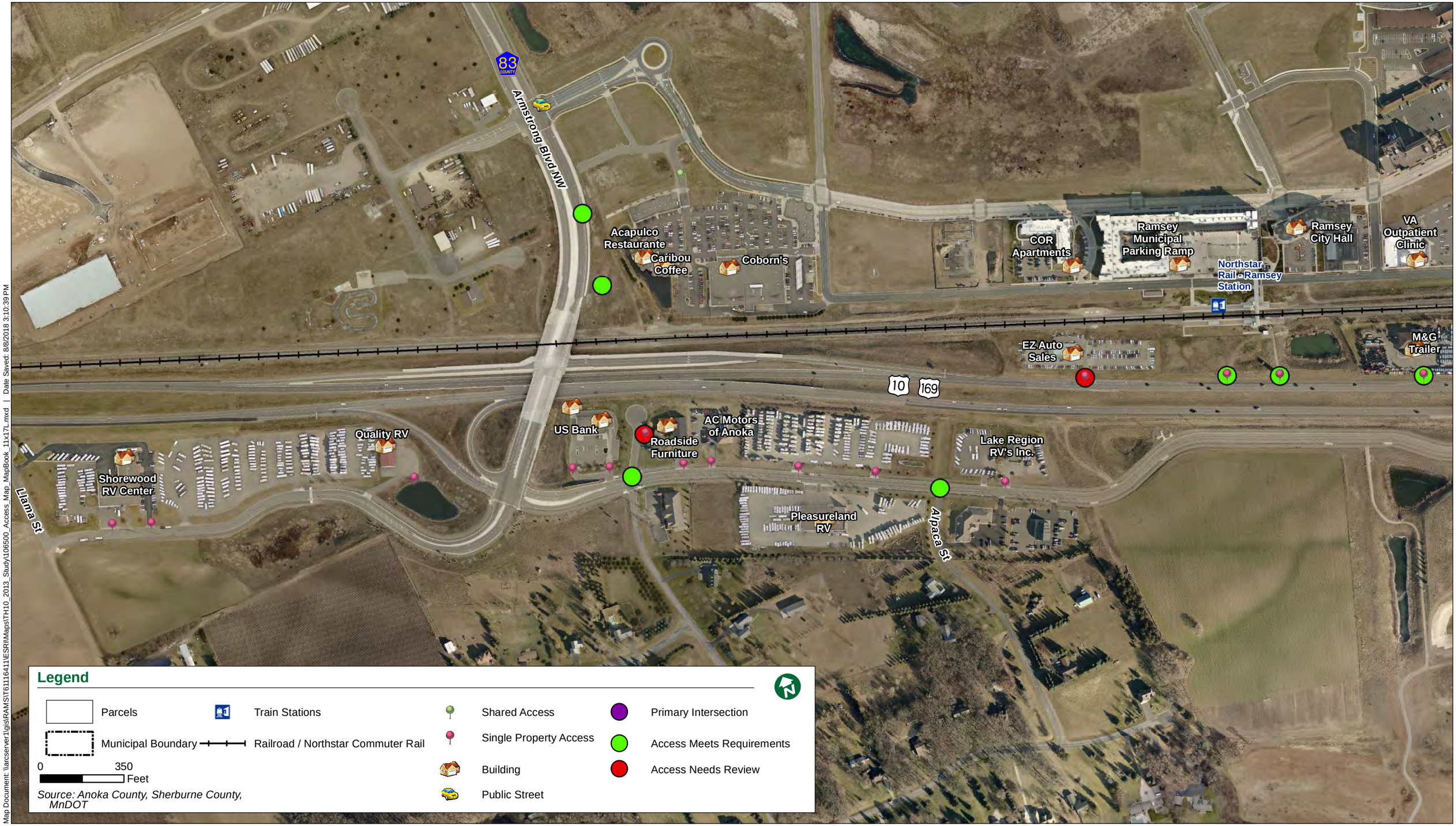
City of RAMSEY

Highway 10 Corridor Improvements

Figure 2D. Access Locations for Properties Adjacent to TH 10

August 2018

BOLTON & MENK
Real People. Real Solutions.



Legend

- Parcels
- Municipal Boundary
- Train Stations
- Railroad / Northstar Commuter Rail
- Shared Access
- Single Property Access
- Building
- Public Street
- Primary Intersection
- Access Meets Requirements
- Access Needs Review

0 350 Feet

Source: Anoka County, Sherburne County, MnDOT

Map Document: \\arcserver1\gis\RAMS\T6\116411\ESRI\Maps\TH10_2013_Study\106500_Access_Map_MapBook_11x17L.mxd | Date Saved: 8/8/2018 3:10:39 PM

City of RAMSEY

Highway 10 Corridor Improvements

Figure 2E. Access Locations for Properties Adjacent to TH 10

August 2018

BOLTON & MENK
Real People. Real Solutions.

Ramsey City Hall
VA Outpatient Clinic
56
Ramsey Blvd NW
M&G Trailer
Anoka-Ramsey Farm & Garden
AmeriGas
RV World
Ferrellgas
Tuff Shed
Burger King
Hirschfield's Ramsey
RM Golf Carts
Auto Fitness and Service Center
Star Auto & Truck Sales
Auto Source Group
Fastenal
YorFit
Eddy's
10
169
Holiday Gas
Heartland Tire
Village Bank
Frederick's Accounting & Tax
Traprock St

Legend

- Parcels
- Municipal Boundary
- Train Stations
- Railroad / Northstar Commuter Rail
- Shared Access
- Single Property Access
- Building
- Public Street
- Primary Intersection
- Access Meets Requirements
- Access Needs Review

0 350 Feet

Source: Anoka County, Sherburne County, MnDOT

Date Saved: 8/8/2018 3:10:39 PM

Map Document: \\arcserver1\gis\RAMS\T6111611\ESRI\Maps\TH10_2013_Study\106500_Access_Map_MapBook_11x17L.mxd

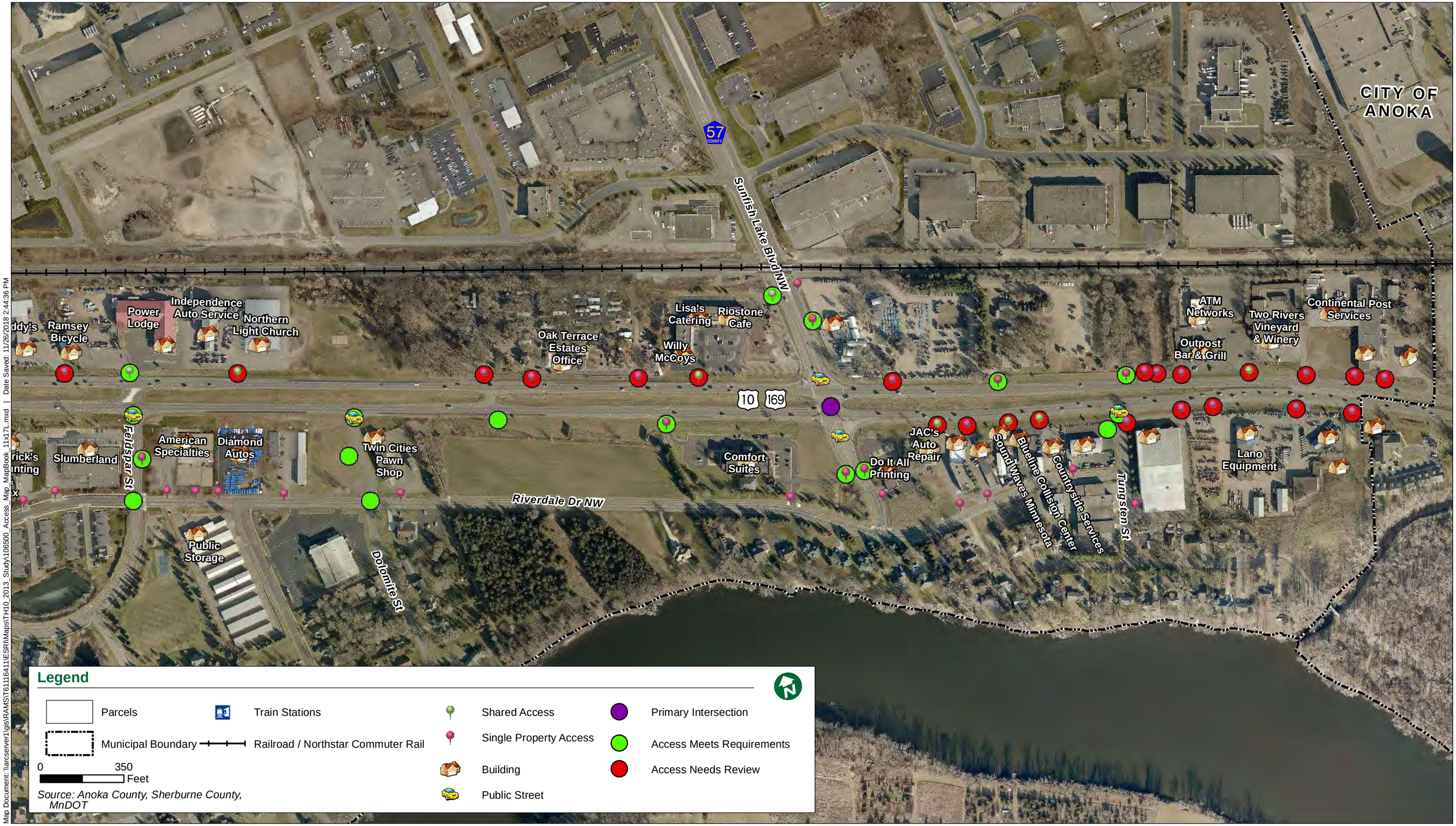
City of RAMSEY

Highway 10 Corridor Improvements

Figure 2F. Access Locations for Properties Adjacent to TH 10

November 2018

BOLTON & MENK
Real People. Real Solutions.



Legend

- Parcels
- Municipal Boundary
- Train Stations
- Railroad / Northstar Commuter Rail
- Shared Access
- Single Property Access
- Building
- Public Street
- Primary Intersection
- Access Meets Requirements
- Access Needs Review

0 350 Feet

Source: Anoka County, Sherburne County, MnDOT

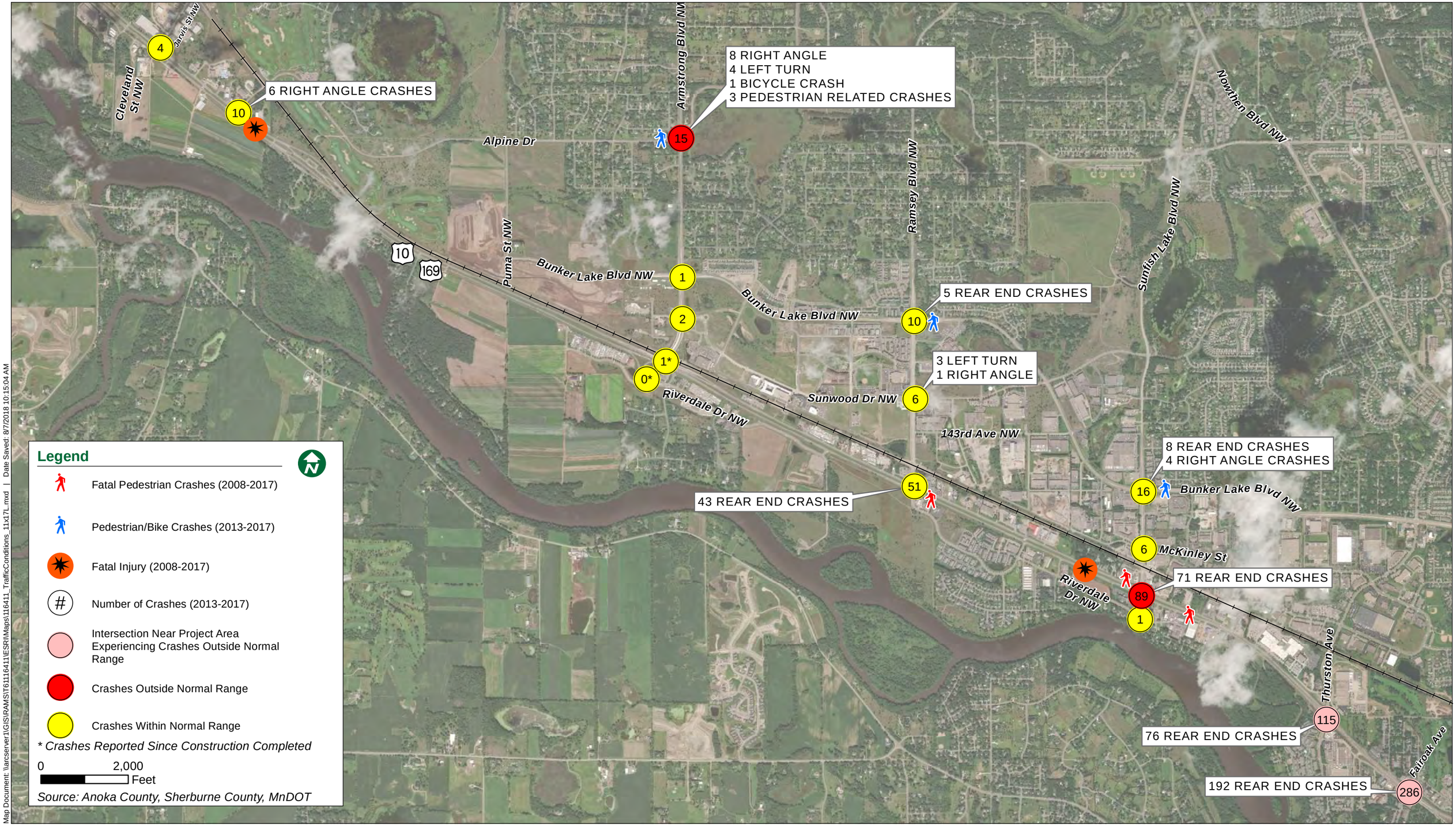
City of RAMSEY

Highway 10 Corridor Improvements

Figure 3. Safety Analysis (2013-2017)

August 2018

BOLTON & MENK
Real People. Real Solutions.



Legend

- Fatal Pedestrian Crashes (2008-2017)
- Pedestrian/Bike Crashes (2013-2017)
- Fatal Injury (2008-2017)
- Number of Crashes (2013-2017)
- Intersection Near Project Area Experiencing Crashes Outside Normal Range
- Crashes Outside Normal Range
- Crashes Within Normal Range

** Crashes Reported Since Construction Completed*

0 2,000 Feet

Source: Anoka County, Sherburne County, MnDOT

City of RAMSEY

Highway 10 Corridor Improvements

Figure 4. Existing (2018) Turning Movement Counts

August 2018

BOLTON & MENK
Real People. Real Solutions.

Map Document: \\Arcserver1\gis\RAMS\T61116411\ESRI\Maps\116411_TMC_Existing.mxd | Date Saved: 8/27/2018 4:39:10 PM

City of RAMSEY

Highway 10 Corridor Improvements

Figure 5. Existing Traffic Operations (West)

August 2018

BOLTON & MENK
Real People. Real Solutions.

Map Document: \\arcserver1\gis\RAMS\T\611\16411\ESRI\Maps\116411_TrafficOperations_Existing_(Figures 5 and 6) DDP_11x17L.mxd | Date Saved: 8/28/2018 2:54:40 PM

Figure 6. Existing Traffic Operations (East)

August 2018

Bunker Lake Blvd NW

Ramsey Blvd NW

Sunwood Dr NW

143rd Ave NW

BNSF RR

36,000

9,800

875'

AM/PM

450'

AM/PM

500'

AM/PM

10

169

40,500

COUNTY 57 ROAD

Sunfish Lake Blvd NW

400'

Bunker Lake Blvd NW

9,600

PM

600'

775'

McKinley St

Riverdale Dr NW

525'

PM

AM

550'

PM

PM

725'

AM

PM

BNSF RR

2250'

Legend

- Intersection Level of Service
- X,XXX Average Annual Daily Traffic (AADT) Volumes
- Movements with Failing LOS

Maximum Queues

AM PM

0 2,000 Feet

Source: Anoka County, Sherburne County, MnDOT

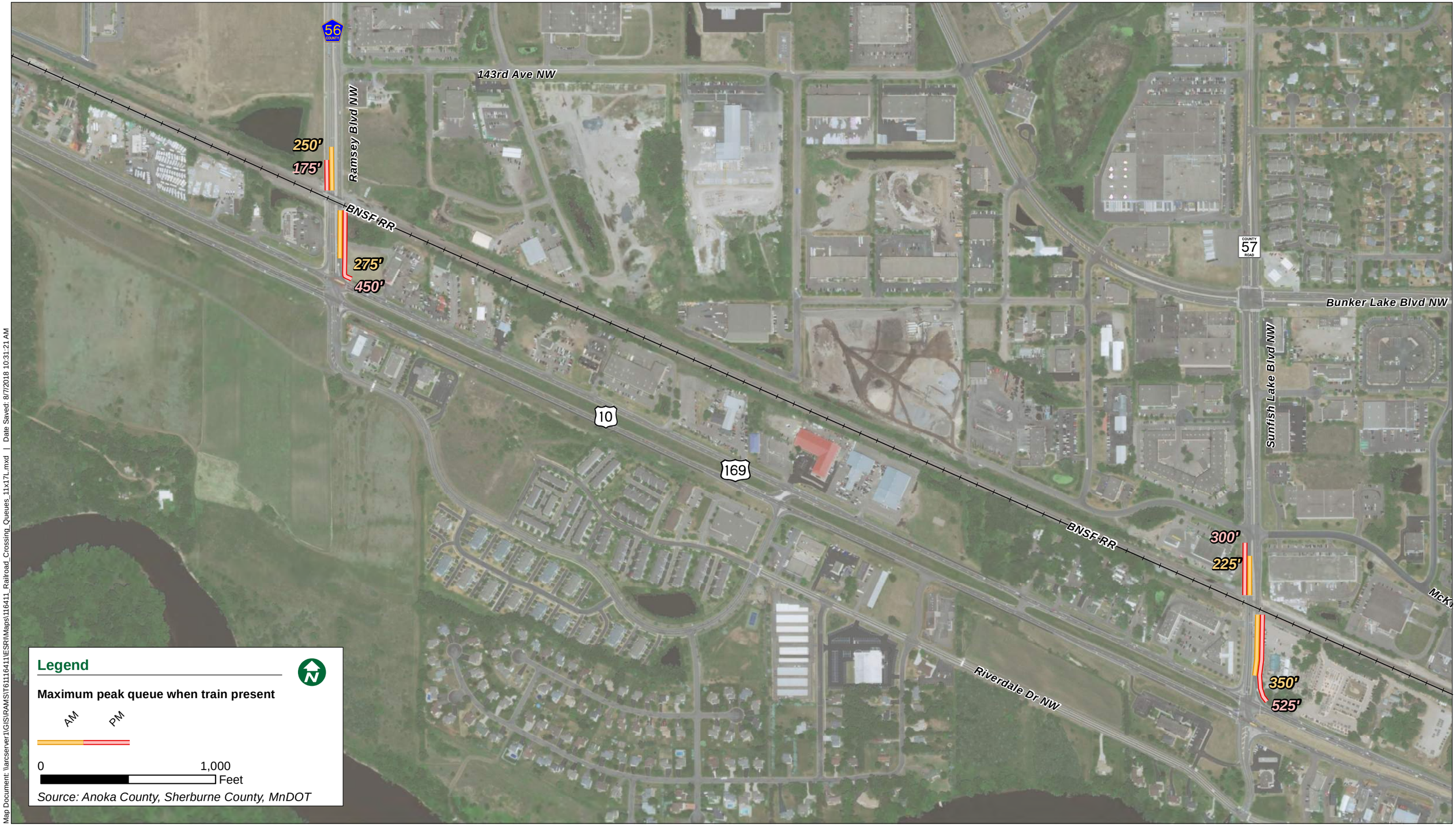
City of RAMSEY

Highway 10 Corridor Improvements

Figure 7. Maximum Queues at Railroad Crossing when Train Present

August 2018

BOLTON & MENK
Real People. Real Solutions.



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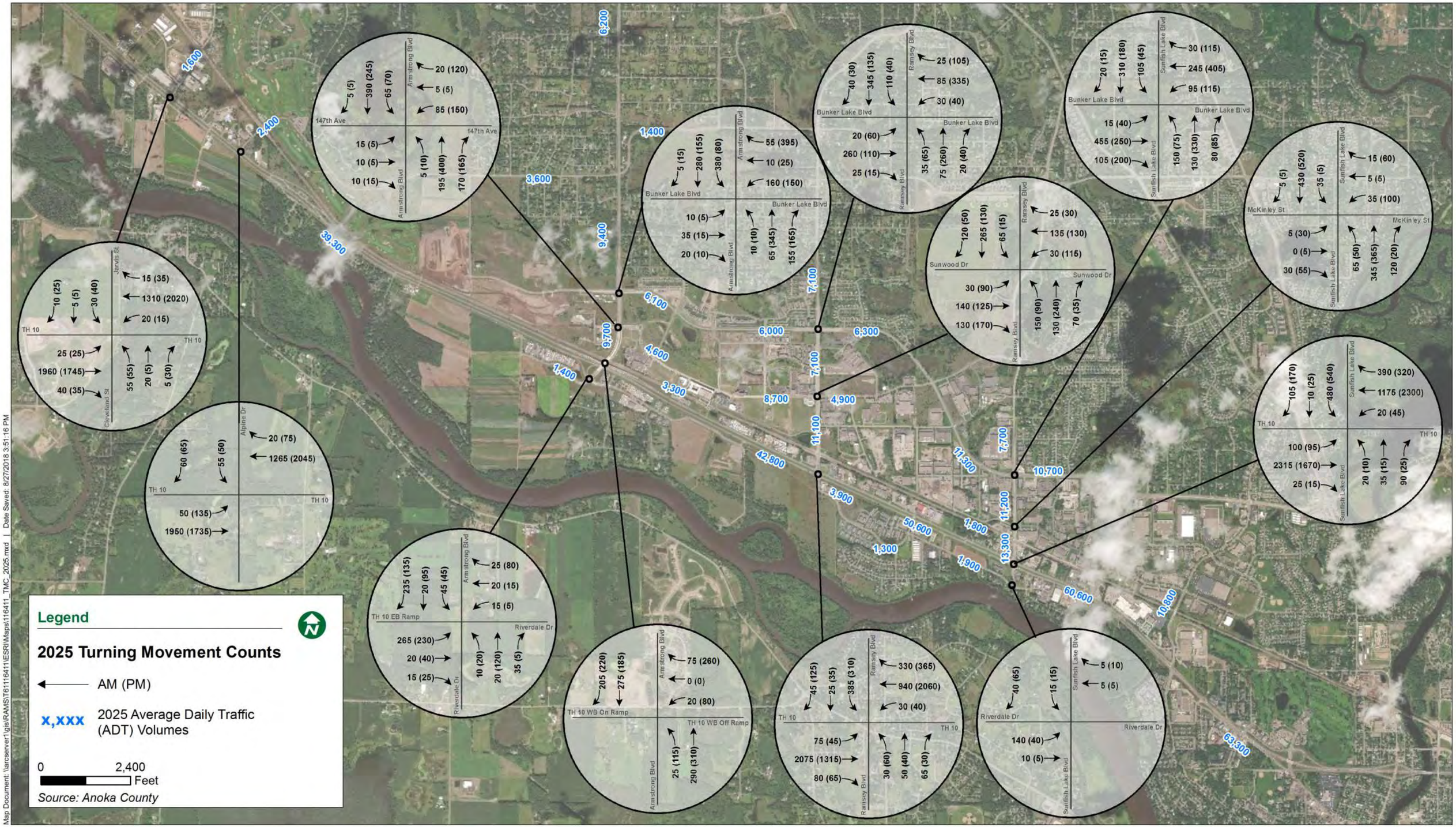
City of RAMSEY

Highway 10 Corridor Improvements

Figure 8. 2025 Turning Movement Counts

August 2018

BOLTON & MENK
Real People. Real Solutions.



Legend

2025 Turning Movement Counts

AM (PM)

x,xxx 2025 Average Daily Traffic (ADT) Volumes

0 2,400 Feet

Source: Anoka County

Map Document: \\arcserver1\gis\RAMS\T\61116411\ESRI\Maps\116411_TMC_2025.mxd | Date Saved: 8/27/2018 3:51:16 PM

City of RAMSEY

Highway 10 Corridor Improvements

Figure 9. 2045 Turning Movement Counts

August 2018

BOLTON & MENK
Real People. Real Solutions.

Legend

2045 Turning Movement Counts

AM (PM)

x,xxx 2045 Average Daily Traffic (ADT) Volumes

0 2,400 Feet

Source: Anoka County

Map Document: \\arcserver1\gis\RAMS\T6116411\ESRI\Maps\116411_TMC_2045.mxd | Date Saved: 8/24/2018 2:33:17 PM

City of RAMSEY

Highway 10 Corridor Improvements

Figure 10. 2025 Traffic Operations (West)

August 2018

BOLTON & MENK
Real People. Real Solutions.

Map Document: \\Arcserver1\GIS\RAMS\T6111641\ESRIMaps\116411_TrafficOperations_2025_(Figures 10 and 11) DDP_11x17L.mxd | Date Saved: 8/28/2018 3:49:38 PM

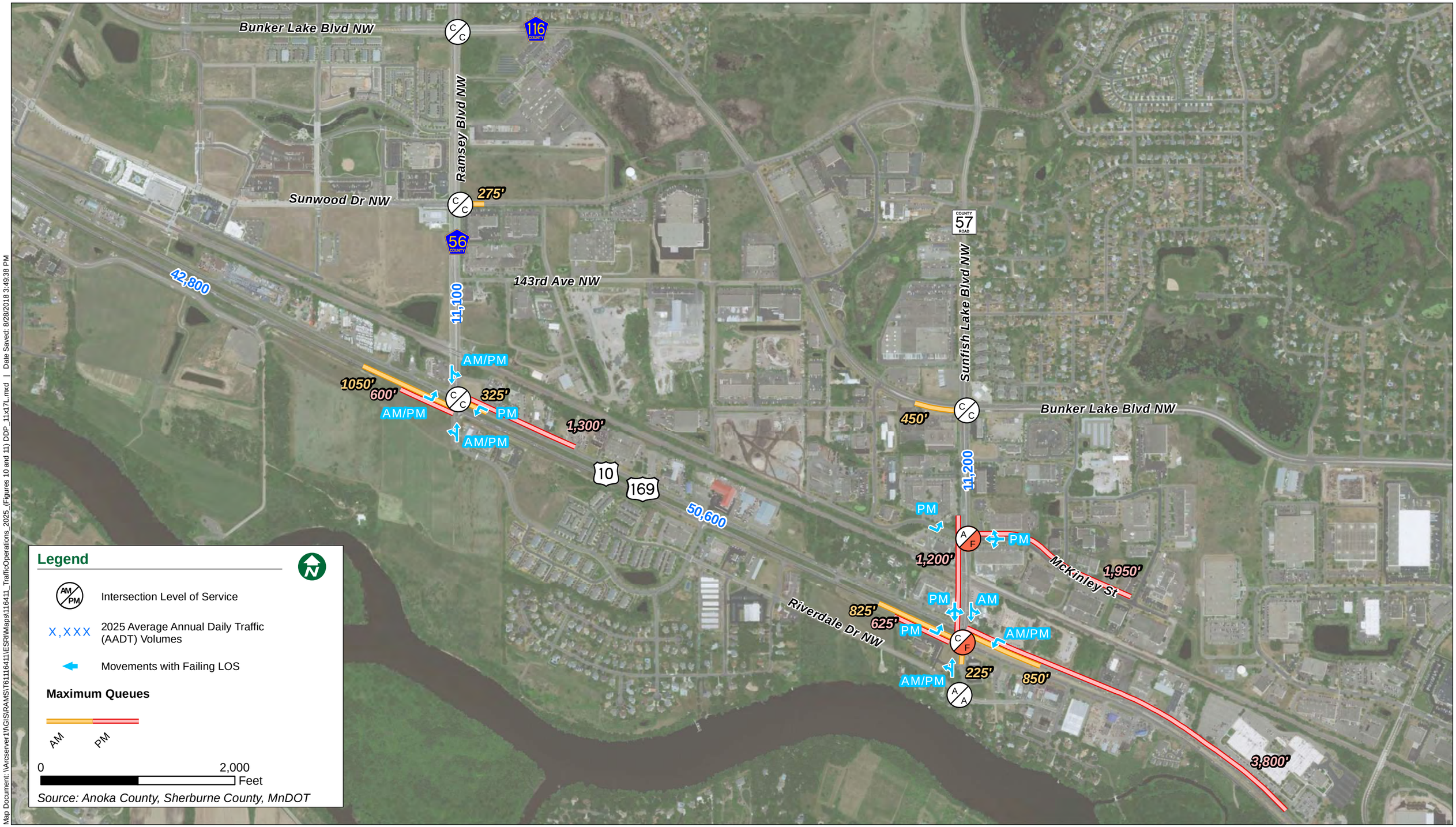


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Figure 12. No Build Maximum Queues at Railroad Crossing when Train Present

August 2018

City of RAMSEY

Highway 10 Corridor Improvements

Figure 13. 2045 Traffic Operations (West)

August 2018

BOLTON & MENK
Real People. Real Solutions.

Legend

- Intersection Level of Service (AM/PM)
- X,XXX — 2045 Average Annual Daily Traffic (AADT) Volumes
- Movements with Failing LOS

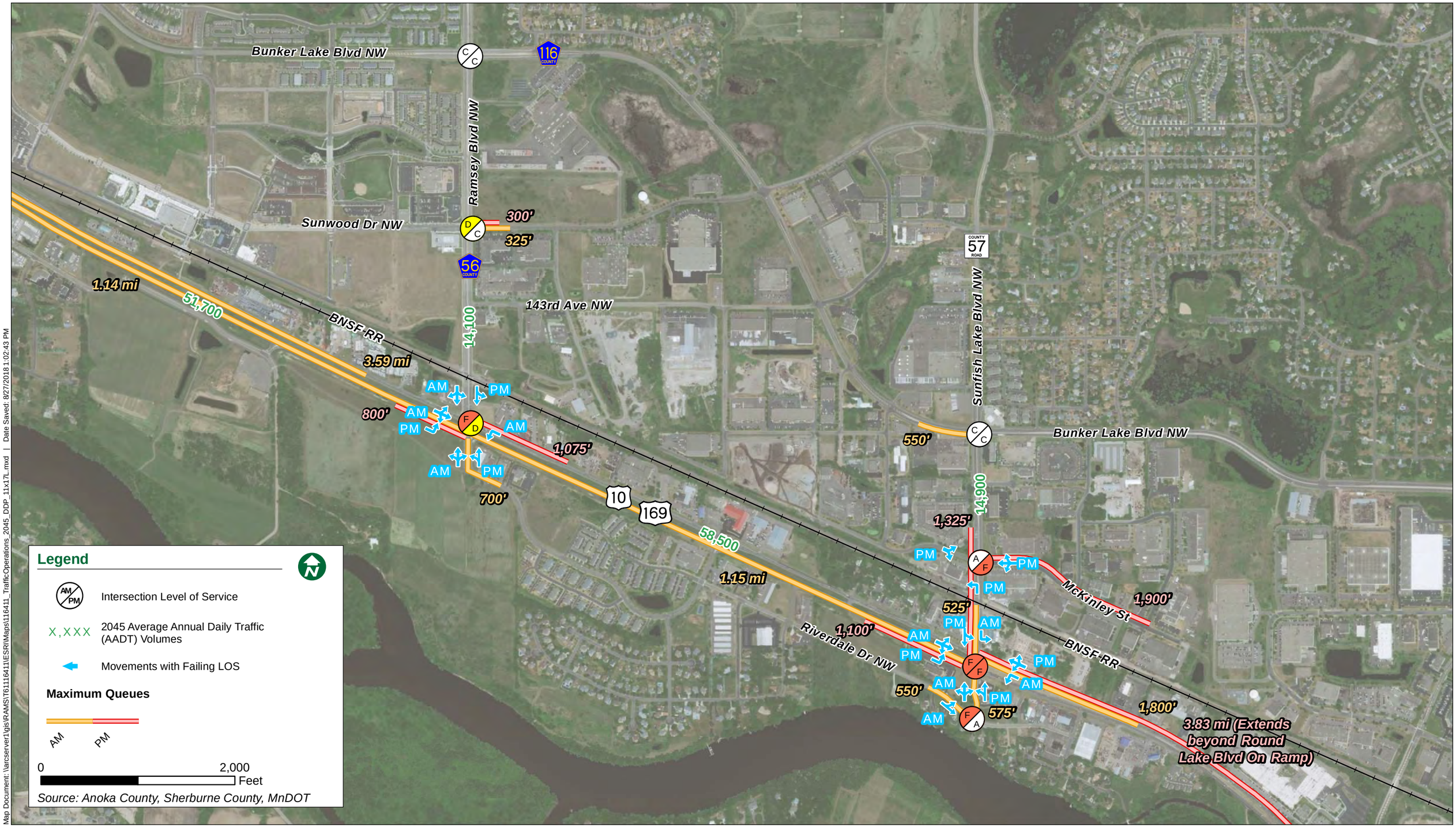
Maximum Queues

AM PM

0 2,000 Feet

Source: Anoka County, Sherburne County, MnDOT

Map Document: \\arcserver1\gis\RAMS\T6111\6411\ESRI\Maps\116411_TrafficOperations_2045_DDP_11x17L.mxd | Date Saved: 8/27/2018 1:02:43 PM



Legend

- Intersection Level of Service
- X,XXX — 2045 Average Annual Daily Traffic (AADT) Volumes
- Movements with Failing LOS

Maximum Queues

AM PM

0 2,000 Feet

Source: Anoka County, Sherburne County, MnDOT

Map Document: \\arcserver1\gis\RAMS\T61116411\ESRI\Maps\116411_TrafficOperations_2045_DDP_11x17L.mxd | Date Saved: 8/27/2018 1:02:43 PM

Figure 15. 2045 No Build Maximum Queues at Railroad Crossing when Train Present

August 2018

Appendix B

Intersection Safety Screening

Intersection: TH 10 at Jarvis St

Crash Data, 2013-2017.

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 *Urban Thru / Stop*

Total Crash Rate	
Observed	0.06
Statewide Average	0.18
Critical Rate	0.32
Critical Index	**0.19**

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.

The observed fatal and serious injury crash rate for this period is 0.00 per 100 MEV; this is 100% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: TH 10 at Alpine St

Crash Data, 2013-2017.

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 *Urban Thru / Stop*

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

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.

The observed fatal and serious injury crash rate for this period is 1.44 per 100 MEV; this is 25% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: TH 10 at Ramsey Blvd

Crash Data, 2013-2017.

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

Signals: high volume, high speed

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

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.

The observed fatal and serious injury crash rate for this period is 1.14 per 100 MEV; this is 43% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: TH 10 and Sunfish Lake Blvd

Crash Data, 2013-2017.

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

Signals: high volume, high speed

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

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.

The observed fatal and serious injury crash rate for this period is 1.00 per 100 MEV; this is 46% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: Armstrong Blvd at Alpine St

Crash Data, 2013-2017.

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 *Urban Thru / Stop*

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

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 Safety Screening

Intersection: Armstrong Blvd at Bunker Lake Blvd

Crash Data, 2013-2017.

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

Signals: low volume, high speed

Total Crash Rate	
Observed	0.07
Statewide Average	0.40
Critical Rate	0.85
Critical Index	**0.08**

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.

The observed fatal and serious injury crash rate for this period is 0.00 per 100 MEV; this is 100% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: Armstrong Blvd at 147th St

Crash Data, 2013-2017.

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

Signals: low volume, high speed

Total Crash Rate	
Observed	0.11
Statewide Average	0.40
Critical Rate	0.80
Critical Index	**0.14**

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.

The observed fatal and serious injury crash rate for this period is 0.00 per 100 MEV; this is 100% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: Ramsey Blvd at Bunker Lake Blvd

Crash Data, 2013-2017.

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

Signals: low volume, low speed

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

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.

The observed fatal and serious injury crash rate for this period is 0.00 per 100 MEV; this is 100% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: Ramsey Blvd at Sunwood Dr

Crash Data, 2013-2017.

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

Signals: low volume, low speed

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

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.

The observed fatal and serious injury crash rate for this period is 0.00 per 100 MEV; this is 100% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: Sunfish Lake Blvd at Bunker Lake Blvd

Crash Data, 2013-2017.

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

Signals: low volume, low speed

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

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.

The observed fatal and serious injury crash rate for this period is 0.00 per 100 MEV; this is 100% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: Sunfish Lake Blvd at McKinley St

Crash Data, 2013-2017.

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 *Urban Thru / Stop*

Total Crash Rate	
Observed	0.29
Statewide Average	0.18
Critical Rate	0.45
Critical Index	**0.64**

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.

The observed fatal and serious injury crash rate for this period is 0.00 per 100 MEV; this is 100% below the critical rate. The intersection operates within the normal range.

Intersection Safety Screening

Intersection: Sunfish Lake Blvd at Riverdale Dr

Crash Data, 2013-2017.

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

Intersection Characteristics	
Entering Volume	1,313
Traffic Control	Thru / stop
Environment	Suburban
Speed Limit	30 mph

Annual crash cost = $16,600

Statewide Comparison *Urban Thru / Stop*

Total Crash Rate	
Observed	0.42
Statewide Average	0.18
Critical Rate	1.10
Critical Index	**0.38**

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.

The observed fatal and serious injury crash rate for this period is 0.00 per 100 MEV; this is 100% below the critical rate. The intersection operates within 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 Severity	
Fatal	0
Incapacitating Injury	3
Non-incapacitating Injury	6
Possible Injury	13
Property Damage	37
Total Crashes	59

Section Characteristics	
Length	2.300 miles
Volume (ADT)	35,500
Environment	Rural
Median Type	Divided / depressed
Number of Lanes	4
Roadway Design	Expressway

Annual crash cost per mile = $355,670

Statewide Comparison *Rural Expressway*

Total Crash Rate	
Observed	0.40
Statewide Average	0.66
Critical Rate	0.83
Critical Index	**0.48**

Fatal & Serious Injury Crash Rate	
Observed	2.01
Statewide Average	1.60
Critical Rate	3.26
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	
Fatal	0
Incapacitating Injury	3
Non-incapacitating Injury	17
Possible Injury	43
Property Damage	155
Total Crashes	218

Section Characteristics	
Length	2.800 miles
Volume (ADT)	47,400
Environment	Suburban
Median Type	Divided / depressed
Number of Lanes	4
Roadway Design	Expressway

Annual crash cost per mile = $667,643

Statewide Comparison *Urban Expressway*

Total Crash Rate	
Observed	0.90
Statewide Average	1.64
Critical Rate	1.85
Critical Index	**0.49**

Fatal & Serious Injury Crash Rate	
Observed	1.24
Statewide Average	2.02
Critical Rate	3.40
Critical Index	**0.36**

Appendix C

Table A1. Existing (2018) AM Peak Hour
7:00-8:00am

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

Table A2. Existing (2018) PM Peak Hour
4:15-5:15pm

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

Table A3. 2025 No Build AM Peak Hour
7:00-8:00am

Location	Aprch	Demand volumes				Modeled Volumes				Model - Demand					GEH	Total Delay by Movement (sec/veh)			Level of Service by Movement			LOS by Approach		LOS		Traffic Queuing (feet)								
																										Left Turn			Through Queue			Right Turn		
		L	T	R	Total	L	T	R	total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St	EB	25	1962	39	2026	23	1949	37	2009	-2	-13	-2	-17	-1%	0	29	1	2	D	A	A	1	A	26	D	250	25	75		25	100	225	25	100
Stop Controlled	WB	19	1308	16	1343	1	1124	37	1162	-18	-184	21	-181	-13%	5	71	1	2	F	A	A	3	A			300	25	50		25	50	250	25	100
	NB	56	18	5	79	33	10	2	45	-23	-8	-3	-34	-43%	4	1417	1550	1602	F	F	F	1455	F				700	1025		700	1025		700	1025
	SB	28	4	9	41	29	5	8	42	1	1	-1	1	2%	0	401	380	317	F	F	F	382	F				100	300		100	300		100	300
TH 10 at Alpine Dr	EB	49	1950		1999	51	1939		1990	2	-11	0	-9	0%	0	11	1	-	B	A	-	1	A	3	A	375	25	100		25	100			
Stop Controlled	WB		1266	21	1287		1098	17	1115	0	-168	-4	-172	-13%	5	-	4	5	-	A	A	4	A							25	25	275	25	25
	SB	53		62	115	52		61	113	-1	0	-1	-2	-2%	0	29	-	12	D	-	B	20	C			225	25	125				225	25	125
Armstrong Blvd at Alpine Dr	EB	10	31	208	249	10	27	210	247	0	-4	2	-2	-1%	0	60	37	41	F	E	E	41	E	24	C		75	375		75	375		75	400
Stop Controlled	WB	20	55	1	76	56	18	1	75	36	-37	0	-1	-1%	0	155	72	180	F	F	F	136	F				75	300		75	300		75	300
	NB	23	99	6	128	19	81	5	105	-4	-18	-1	-23	-18%	2	7	4	5	A	A	A	4	A				25	75		0	0	275	0	0
	SB	2	432	18	452	2	429	16	447	0	-3	-2	-5	-1%	0	1	0	0	A	A	A	0	A				25	25		0	0	250	0	0
Armstrong Blvd at Bunker Lake Blvd	EB	10	17	31	58	8	16	33	57	-2	-1	2	-1	-2%	0	49	43	1	D	D	A	20	B	24	C	300	25	50		25	75	300	25	50
Signalized Intersection	WB	159	12	49	220	150	10	51	211	-9	-2	2	-9	-4%	1	37	33	7	D	C	A	30	C			225	25	125		25	50	300	25	75
	NB	13	12	49	74	15	49	122	186	2	37	73	112	151%	10	47	24	10	D	C	B	17	B			325	25	50		25	75	285	25	100
	SB	409	270	2	681	430	272	3	705	21	2	1	24	4%	1	39	2	5	D	A	A	24	C			300	125	575		25	75	300	0	0
147th St at Armstrong Blvd	EB	13	8	10	31	13	9	8	30	0	1	-2	-1	-3%	0	25	29	8	C	C	A	22	C	9	A	200	25	50		25	50	200	25	50
Signalized Intersection	WB	80	1	21	102	79	1	19	99	-1	0	-2	-3	-3%	0	20	11	18	C	B	B	20	B			275	25	75		25	25	275	25	50
	NB	1	193	170	364	1	152	146	299	0	-41	-24	-65	-18%	4	30	9	4	C	A	A	7	A			300	25	25		25	75	300	25	75
	SB	64	389	7	460	57	398	7	462	-7	9	0	2	0%	0	19	6	3	B	A	A	8	A			350	25	100		25	150	175	25	25
WB TH 10 Ramps at Armstrong Blvd	WB	19		76	95	13		54	67	-6	0	-22	-28	-29%	3	42	-	8	D	-	A	14	B	6	A	600	25	75				600	25	50
Signalized Intersection	NB	26	288		314	20	244		264	-6	-44	0	-50	-16%	3	21	1	-	C	A	-	3	A			350	25	50		25	75			
	SB		277	207	484		271	216	487	0	-6	9	3	1%	0	-	40	38	-	D	D	39	D							25	125	250	25	150
EB TH 10 Ramps at Armstrong Blvd	EB	266	22	14	302	218	19	11	248	-48	-3	-3	-54	-18%	3	19	17	11	C	C	B	1	A	3	A	225	25	175		25	50	225	25	50
Stop Controlled	WB	14	19	27	60	14	17	26	57	0	-2	-1	-3	-5%	0	12	12	6	B	B	A	2	A			200	25	50		25	50	225	0	0
	NB	8	21	37	66	10	21	35	66	2	0	-2	0	0%	0	6	0	1	A	A	A	0	A			275	25	50		0	0	275	0	0
	SB	43	20	233	296	43	23	218	284	0	3	-15	-12	-4%	1	1	2	3	A	A	A	11	B				0	0		0	0		0	0
Bunker Lake Blvd at Ramsey Blvd	EB	17	231	24	272	16	258	23	297	-1	27	-1	25	9%	1	36	24	7	D	C	A	23	C	21	C	285	25	75		50	150	285	25	50
Signalized Intersection	WB	31	84	24	139	32	81	21	134	1	-3	-3	-5	-4%	0	37	20	5	D	C	A	22	C			285	25	100		25	75	285	25	50
	NB	20	74	36	130	32	115	52	199	12	41	16	69	53%	5	36	21	6	D	C	A	20	B			785	25	75		25	100	285	25	75
	SB	110	344	42	496	104	343	46	493	-6	-1	4	-3	-1%	0	32	17	6	C	B	A	19	B			285	25	150		25	150	285	25	50
Sunwood Dr at Ramsey Blvd	EB	32	138	130	300	29	136	131	296	-3	-2	1	-4	-1%	0	40	25	5	D	C	A	18	B	23	C	350	25	125		25	150	250	25	75
Signalized Intersection	WB	30	135	23	188	30	131	23	184	0	-4	0	-4	-2%	0	38	25	23	D	C	C	27	C			225	25	75		25	275		25	275
	NB	149	128	70	347	184	148	90	422	35	20	20	75	22%	4	43	21	12	D	C	B	29	C			700	50	425		25	125	300	25	100
	SB	66	266	120	452	56	227	112	395	-10	-39	-8	-57	-13%	3	41	21	6	D	C	A	20	B			300	25	150		25	150	300	25	125
TH 10 at Ramsey Blvd	EB	77	2076	82	2235	61	1855	71	1987	-16	-221	-11	-248	-11%	5	104	21	8	F	C	A	23	C	33	C	575	50	200		150	1050	400	25	50
Signalized Intersection	WB	29	939	328	1296	32	897	322	1251	3	-42	-6	-45	-3%	1	79	14	8	E	B	A	14	B			775	25	150		50	325	275	25	125
	NB	30	50	65	145	26	51	66	143	-4	1	1	-2	-1%	0	81	105	20	F	F	C	61	E			300	25	75		50	175	225	25	125
	SB	384	25	44	453	310	20	37	367	-74	-5	-7	-86	-19%	4	133	480	41	F	F	D	143	F			1000	25	275		25	75	125	25	75
Bunker Lake Blvd at Sunfish Lake Blvd	EB	16	453	105	574	12	452	106	570	-4	-1	1	-4	-1%	0	40	43	7	D	D	A	36	D	29	C	450	25	75		75	450	300	25	100
Signalized Intersection	WB	95	246	32	373	93	240	34	367	-2	-6	2	-6	-2%	0	32	23	5	C	C	A	24	C			400	25	175		25	175	300	25	50
	NB	149	130	80	359	147	114	82	343	-2	-16	2	-16	-4%	1	39	25	6	D	C	A	24	C			425	50	250		25	100	325	25	100
	SB	107	312	20	439	111	309	19	439	4	-3	-1	0	0%	0	31	26	5	C	C	A	26	C			400	25	200		50	175	350	25	50
McKinley St. at Sunfish Lake Blvd	EB	0	0	28	28	0	0	26	26	0	0	-2	-2	-7%	0	0	0	9	A	A	A	9	A	3	A		25	50		25	50		25	75
Stop Controlled	WB	36	3	12	51	34	5	13	52	-2	2	1	1	2%	0	27	20	19	D	C	C	25	C				25	100	75	25	100		25	125
	NB	63	345	119	527	59	328	125	512	-4	-17	6	-15	-3%	1	6	3	2	A	A	A	3	A			125	25	100		25	25	175	25	50
	SB	35	432	0	467	36	470	0	506	1	38	0	39	8%	2	10	0	0	B	A	A	1	A			325	25	75		25	50	325	25	50
TH 10 at Sunfish Lake Blvd	EB	101	2313	24	2438	91	2157	19	2267	-10	-156	-5	-171	-7%	4	73	14	7	E	B	A	17	B	32	C	750	50	275		100	825	250	25	50
Signalized Intersection	WB	21	1175	390	1586	20	1199	385	1604	-1	24	-5	18	1%	0	89	32	9	F	C	A	27	C			700	25	125		150	850	675	25	125
	NB	20	36	92	148	17	35	95	147	-3	-1	3	-1	-1%	0	84	110	56	F	F	E	72	E			150	25	125		25	150	175	50	225
	SB	478	10	106	594	425	9	94	528	-53	-1	-12	-66	-11%	3	115	111	47	F	F	D	103	F			675	150	450		25	150	225	25	150
Riverdale Dr at Sunfish Lake Blvd	EB	142	10		152	142	8		150	0	-2	0	-2	-1%	0	0	0	-	A	A	-	0	A	2	A		0	0		0	0			
Stop Controlled	WB		0	6	6		0	5	5	0	0	-1	-1	-17%	0	-	0	0	-	A	A	0	A							0	0		0	0
	SB	15		40	55	15		33	48	0	0	-7	-7	-13%	1	10	-	10	B	-	B	10	B				25	75					25	75

Table A4. 2025 No Build PM Peak Hour
4:15-5:15pm

Location	Aprch	Demand volumes				Modeled Volumes				Model - Demand					GEH	Total Delay by Movement (sec/veh)			Level of Service by Movement			LOS by Approach		LOS		Traffic Queuing (feet)								
																										Left Turn			Through Queue			Right Turn		
		L	T	R	Total	L	T	R	total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St	EB	25	1743	34	1802	23	1729	33	1785	-2	-14	-1	-17	-1%	0	74	1	2	F	A	A	2	A	17	C	250	25	100		25	25	225	25	25
Stop Controlled	WB	13	2020	35	2068	8	2052	33	2093	-5	32	-2	25	1%	1	30	2	2	D	A	A	3	A			300	25	100		25	200	250	25	25
	NB	53	5	30	88	32	5	22	59	-21	0	-8	-29	-33%	3	1347	613	610	F	F	F	1010	F				650	975		650	975		675	1000
	SB	25	5	38	68	6	1	8	15	-19	-4	-30	-53	-78%	8	179	299	81	F	F	F	135	F				25	125		25	125		25	125
TH 10 at Alpine Dr	EB	136	1737		1873	129	1638		1767	-7	-99	0	-106	-6%	2	42	1	-	E	A	-	4	A	10	B	375	50	275		25	75			
Stop Controlled	WB		2045	77	2122		2043	80	2123	0	-2	3	1	0%	0	-	12	12	-	B	B	12	B							25	175	275	25	50
	SB	51		63	114	45		62	107	-6	0	-1	-7	-6%	1	147	-	17	F	-	C	72	F			225	50	275				225	50	250
Armstrong Blvd at Alpine Dr	EB	74	58	13	145	73	54	15	142	-1	-4	2	-3	-2%	0	25	23	19	D	C	C	24	C	11	B		25	175		25	175		25	200
Stop Controlled	WB	30	25	15	70	27	30	13	70	-3	5	-2	0	0%	0	23	16	16	C	C	C	9	A				25	100		25	100		25	100
	NB	149	456	66	671	92	296	46	434	-57	-160	-20	-237	-35%	10	10	9	7	A	A	A	19	C				25	125		0	0	275	0	0
	SB	9	151	3	163	10	146	5	161	1	-5	2	-2	-1%	0	4	0	0	A	A	A	0	A				25	75		0	0	250	0	0
Armstrong Blvd at Bunker Lake Blvd	EB	1	13	11	25	0	3	13	16	-1	-10	2	-9	-36%	2	40	40	1	D	D	A	8	A	11	B	300	25	25		25	25	300	25	25
Signalized Intersection	WB	152	152	394	698	49	6	118	173	-103	-146	-276	-525	-75%	25	35	32	8	D	C	A	16	B			225	25	75		25	75	300	25	75
	NB	10	345	167	522	9	319	159	487	-1	-26	-8	-35	-7%	2	33	10	7	C	A	A	9	A			325	25	50		25	125	285	25	100
	SB	80	155	15	250	64	113	12	189	-16	-42	-3	-61	-24%	4	31	1	1	C	A	A	11	B			300	25	125		0	0	300	0	0
147th St at Armstrong Blvd	EB	5	3	5	13	5	3	5	13	0	0	0	0	0%	0	26	24	6	C	C	A	18	B	11	B	200	25	50		25	25	200	25	25
Signalized Intersection	WB	139	5	108	252	140	4	107	251	1	-1	-1	-1	0%	0	17	16	18	B	B	B	18	B			275	25	100		25	50	275	25	125
	NB	8	398	164	570	7	375	159	541	-1	-23	-5	-29	-5%	1	22	10	5	C	A	A	8	A			300	25	50		25	150	300	25	75
	SB	72	264	246	582	35	142	3	180	-37	-122	-243	-402	-69%	21	22	7	2	C	A	A	10	B			350	25	75		25	100	175	25	25
WB TH 10 Ramps at Armstrong Blvd	WB	82		258	340	76		238	314	-6	0	-20	-26	-8%	1	41	-	11	D	-	B	18	B	4	A	600	25	200				600	25	100
Signalized Intersection	NB	117	312		429	125	303		428	8	-9	0	-1	0%	0	26	4	-	C	A	-	10	B			350	25	150		25	150			
	SB		187	222	409		126	164	290	0	-61	-58	-119	-29%	6	-	13	7	-	B	A	10	A							25	75	250	25	125
EB TH 10 Ramps at Armstrong Blvd	EB	228	42	26	296	232	43	26	301	4	1	0	5	2%	0	32	17	10	D	C	B	1	A	3	A	225	50	300		25	75	225	25	75
Stop Controlled	WB	6	14	82	102	7	11	81	99	1	-3	-1	-3	-3%	0	14	11	6	B	B	A	4	A			200	25	50		25	50	225	0	0
	NB	19	119	7	145	20	114	10	144	1	-5	3	-1	-1%	0	4	0	1	A	A	A	0	A			275	25	50		0	0	275	0	0
	SB	44	90	135	269	39	56	108	203	-5	-34	-27	-66	-25%	4	1	1	1	A	A	A	2	A				0	0		0	0		0	0
Bunker Lake Blvd at Ramsey Blvd	EB	60	109	14	183	87	157	24	268	27	48	10	85	46%	6	37	21	6	D	C	A	25	C	23	C	285	25	150		25	125	285	25	50
Signalized Intersection	WB	38	337	103	478	42	423	144	609	4	86	41	131	27%	6	39	26	7	D	C	A	22	C			285	25	125		50	225	285	25	100
	NB	65	258	41	364	66	289	48	403	1	31	7	39	11%	2	38	24	6	D	C	A	24	C			785	25	150		25	225	285	25	75
	SB	38	135	28	201	33	138	28	199	-5	3	0	-2	-1%	0	38	22	7	D	C	A	23	C			285	25	75		25	100	285	25	50
Sunwood Dr at Ramsey Blvd	EB	91	123	171	385	90	120	172	382	-1	-3	1	-3	-1%	0	33	26	6	C	C	A	19	B	26	C	350	25	150		25	150	250	25	100
Signalized Intersection	WB	114	130	31	275	119	128	27	274	5	-2	-4	-1	0%	0	35	25	26	D	C	C	29	C			225	25	175		25	200		25	200
	NB	89	242	36	367	114	283	45	442	25	41	9	75	20%	4	45	30	19	D	C	B	33	C			700	25	250		25	225	300	25	75
	SB	12	131	50	193	8	138	58	204	-4	7	8	11	6%	1	41	22	6	D	C	A	18	B			300	25	75		25	100	300	25	100
TH 10 at Ramsey Blvd	EB	46	1315	67	1428	53	1398	67	1518	7	83	0	90	6%	2	103	18	6	F	B	A	21	C	27	C	575	50	200		100	600	400	25	50
Signalized Intersection	WB	40	2060	364	2464	41	2001	348	2390	1	-59	-16	-74	-3%	2	81	15	13	F	B	B	16	B			775	25	150		100	1300	275	25	150
	NB	60	42	32	134	60	40	34	134	0	-2	2	0	0%	0	93	100	10	F	F	B	74	E			300	50	125		25	125	225	25	75
	SB	309	34	123	466	282	32	115	429	-27	-2	-8	-37	-8%	2	120	110	40	F	F	D	98	F			1000	25	250		25	250	125	25	250
Bunker Lake Blvd at Sunfish Lake Blvd	EB	41	249	200	490	39	258	197	494	-2	9	-3	4	1%	0	32	39	6	C	D	A	26	C	24	C	450	25	125		50	225	300	25	125
Signalized Intersection	WB	116	405	115	636	117	402	114	633	1	-3	-1	-3	0%	0	32	27	6	C	C	A	24	C			400	25	200		50	275	300	25	75
	NB	76	330	87	493	75	320	87	482	-1	-10	0	-11	-2%	0	33	23	5	C	C	A	24	C			425	25	175		25	250	325	25	75
	SB	47	180	13	240	52	174	14	240	5	-6	1	0	0%	0	32	25	6	C	C	A	26	C			400	25	125		25	125	350	25	50
McKinley St. at Sunfish Lake Blvd	EB	30	1	55	86	29	1	54	84	-1	0	-1	-2	-2%	0	62	16	44	F	C	E	50	E	138	F		25	200		25	200		50	200
Stop Controlled	WB	100	1	61	162	152	1	71	224	52	0	10	62	38%	4	726	97	679	F	F	F	708	F				975	1925	75	975	1925		1000	1950
	NB	50	363	19	432	58	373	16	447	8	10	-3	15	3%	1	44	7	6	E	A	A	11	B			125	25	300		25	50	175	25	125
	SB	5	518	1	524	2	480	1	483	-3	-38	0	-41	-8%	2	6	8	1	A	A	A	8	A			325	25	25		25	25	325	25	25
TH 10 at Sunfish Lake Blvd	EB	95	1668	13	1776	91	1646	12	1749	-4	-22	-1	-27	-2%	1	164	19	10	F	B	B	26	C	84	F	750	100	325		100	625	250	25	25
Signalized Intersection	WB	44	2300	321	2665	42	2338	338	2718	-2	38	17	53	2%	1	132	68	54	F	E	D	67	E			700	50	200		1350	3800	675	700	2850
	NB	12	16	25	53	9	16	25	50	-3	0	0	-3	-6%	0	81	100	21	F	F	C	57	E			150	25	75		25	75	175	25	75
	SB	538	23	171	732	502	21	159	682	-36	-2	-12	-50	-7%	2	301	278	290	F	F	F	298	F			675	375	1200		25	275	225	75	400
Riverdale Dr at Sunfish Lake Blvd	EB	42	7		49	41	6		47	-1	-1	0	-2	-4%	0	1	1	-	A	A	-	1	A	5	A		0	0		0	0			
Stop Controlled	WB		6	10	16		6	9	15	0	0	-1	-1	-6%	0	-	0	1	-	A	A	0	A							0	0		0	0
	SB	10		67	77	16		60	76	6	0	-7	-1	-1%	0	10	-	9	B	-	A	9	A				25	150					25	150

Table A5. 2045 No Build AM Peak Hour
7:00-8:00am

Location	Aprch	Demand volumes				Modeled Volumes				Model - Demand					GEH	Total Delay by Movement (sec/veh)			Level of Service by Movement			LOS by Approach		LOS		Traffic Queuing (feet)								
																										Left Turn			Through Queue			Right Turn		
		L	T	R	Total	L	T	R	total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St	EB	31	2359	78	2468	14	1346	56	1416	-17	-1013	-22	-1052	-43%	24	145	82	41	F	F	E	81	F	211	F	250	25	75		900	1825	225	900	1825
	WB	102	1526	18	1646	4	235	6	245	-98	-1291	-12	-1401	-85%	46	3749	853	994	F	F	F	904	F			300	10950	18975		2200	2425	250	900	1825
Stop Controlled	NB	156	48	38	242	0	0	0	0	-156	-48	-38	-242	-100%	22	3600	3600	3600	F	F	F	3600	F				1000	1000		1000	1000		1000	1000
	SB	13	22	43	78	0	0	0	0	-13	-22	-43	-78	-100%	12	3600	3600	3600	F	F	F	3600	F				2825	2850		2825	2850		2825	2875
TH 10 at Alpine Dr	EB	73	2339		2412	7	1228		1235	-66	-1111		-1177	-49%	28	14	96	0	B	F	A	96	F	250	F	375	3400	4800		1500	2550			
	WB		1533	36	1569		294	12	306		-1239	-24	-1263	-80%	41	0	775	726	A	F	F	773	F							6250	10900	275	0	0
Stop Controlled	SB	103		84	187	13		11	24	-90		-73	-163	-87%	16	63	0	456	F	A	F	243	F			225	675	850				225	675	850
Armstrong Blvd at Alpine Dr	EB	12	56	366	434	8	41	276	325	-4	-15	-90	-109	-25%	6	709	706	609	F	F	F	624	F	184	F		2200	3625		2200	3625		2225	3650
	WB	40	98	1	139	36	96	1	133	-4	-2	0	-6	-4%	1	110	62	106	F	F	F	75	F				75	325		75	325		75	325
Stop Controlled	NB	64	120	10	194	55	108	10	173	-9	-12	0	-21	-11%	2	11	6	4	B	A	A	8	A				25	100		0	0	275	0	0
	SB	5	492	35	532	6	489	34	529	1	-3	-1	-3	-1%	0	1	0	0	A	A	A	0	A				25	25		0	0	250	0	0
Armstrong Blvd at Bunker Lake Blvd	EB	20	54	37	111	21	51	39	111	1	-3	2	0	0%	0	49	46	2	D	D	A	31	C	30	C	300	25	100		25	175	300	25	50
	WB	302	27	87	416	288	27	89	404	-14	0	2	-12	-3%	1	43	34	7	D	C	A	34	C			225	50	225		25	75	300	25	75
Signalized Intersection	NB	21	87	266	374	17	65	215	297	-4	-22	-51	-77	-21%	4	59	31	13	E	C	B	19	B			325	25	50		25	75	285	25	175
	SB	555	340	3	898	496	304	4	804	-59	-36	1	-94	-10%	3	49	3	3	D	A	A	31	C			300	200	775		25	275	300	0	0
147th St at Armstrong Blvd	EB	25	17	51	93	24	17	51	92	-1	0	0	-1	-1%	0	28	30	9	C	C	A	18	B	12	B	200	25	75		25	75	200	25	75
	WB	120	4	32	156	119	5	30	154	-1	1	-2	-2	-1%	0	22	15	19	C	B	B	21	C			275	25	100		25	25	275	25	75
Signalized Intersection	NB	4	314	220	538	4	244	170	418	0	-70	-50	-120	-22%	5	29	11	5	C	B	A	9	A			300	25	50		25	125	300	25	100
	SB	94	570	15	679	84	531	13	628	-10	-39	-2	-51	-8%	2	26	8	3	C	A	A	10	B			350	25	125		25	250	175	25	25
WB TH 10 Ramps at Armstrong Blvd	WB	143		108	251	92		71	163	-51	0	-37	-88	-35%	6	39		9	D	A	A	26	C	14	B	600	25	175		0	0	600	25	75
	NB	159	421		580	130	347		477	-29	-74	0	-103	-18%	4	28	3		C	A	A	10	A			350	25	150		25	150			
Signalized Intersection	SB		465	276	741		434	268	702	0	-31	-8	-39	-5%	1		16	9	A	B	A	14	B							25	200	250	25	200
EB TH 10 Ramps at Armstrong Blvd	EB	385	40	22	447	277	28	20	325	-108	-12	-2	-122	-27%	6	114	63	14	F	F	B	4	A	31	D	225	350	1975		25	50	225	25	75
	WB	26	26	125	177	25	27	120	172	-1	1	-5	-5	-3%	0	16	18	7	C	C	A	3	A			200	25	75		25	75	225	0	0
Stop Controlled	NB	22	82	80	184	30	82	77	189	8	0	-3	5	3%	0	8	0	1	A	A	A	1	A			275	25	50		0	0	275	0	0
	SB	95	104	409	608	80	88	357	525	-15	-16	-52	-83	-14%	3	1	5	5	A	A	A	13	B				0	0		0	0		0	0
Bunker Lake Blvd at Ramsey Blvd	EB	25	368	38	431	24	365	38	427	-1	-3	0	-4	-1%	0	40	25	13	D	C	B	25	C	24	C	285	25	75		50	175	285	25	75
	WB	43	108	31	182	41	106	30	177	-2	-2	-1	-5	-3%	0	43	23	5	D	C	A	25	C			285	25	100		25	100	285	25	50
Signalized Intersection	NB	46	90	34	170	42	91	32	165	-4	1	-2	-5	-3%	0	37	25	6	D	C	A	24	C			785	25	125		25	100	285	25	75
	SB	130	433	50	613	123	423	53	599	-7	-10	3	-14	-2%	1	36	21	6	D	C	A	23	C			285	50	200		50	275	285	25	50
Sunwood Dr at Ramsey Blvd	EB	43	175	168	386	40	167	163	370	-3	-8	-5	-16	-4%	1	41	27	35	D	C	C	32	C	37	D	350	25	125		25	275	250	50	175
	WB	33	159	27	219	32	151	30	213	-1	-8	3	-6	-3%	0	62	27	26	E	C	C	32	C			225	25	100		50	325		50	325
Signalized Intersection	NB	200	154	85	439	184	147	87	418	-16	-7	2	-21	-5%	1	44	24	10	D	C	B	30	C			700	50	400		25	125	300	25	100
	SB	78	322	142	542	76	299	141	516	-2	-23	-1	-26	-5%	1	62	71	45	E	E	D	62	E			300	25	175		125	375	300	25	250
TH 10 at Ramsey Blvd	EB	125	2434	104	2663	113	2276	95	2484	-12	-158	-9	-179	-7%	4	284	212	185	F	F	F	214	F	164	F	575	75	325		4000	6000	400	25	50
	WB	45	1112	376	1533	46	1105	382	1533	1	-7	6	0	0%	0	98	21	12	F	C	B	21	C			775	50	200		75	525	275	25	250
Signalized Intersection	NB	35	60	75	170	26	39	55	120	-9	-21	-20	-50	-29%	4	443	519	793	F	F	F	628	F			300	25	100		175	700	225	550	975
	SB	460	32	71	563	426	23	63	512	-34	-9	-8	-51	-9%	2	274	757	335	F	F	F	303	F			1000	150	600		100	250	125	100	250
Bunker Lake Blvd at Sunfish Lake Blvd	EB	21	547	146	714	22	537	142	701	1	-10	-4	-13	-2%	0	36	46	9	D	D	A	38	D	34	C	450	25	75		100	550	300	25	125
	WB	112	297	37	446	111	283	35	429	-1	-14	-2	-17	-4%	1	35	28	5	D	C	A	28	C			400	50	200		50	225	300	25	50
Signalized Intersection	NB	193	137	96	426	193	136	109	438	0	-1	13	12	3%	1	57	27	8	E	C	A	28	C			425	75	350		25	150	325	25	100
	SB	115	340	25	480	113	338	25	476	-2	-2	0	-4	-1%	0	34	29	6	C	C	A	29	C			400	25	200		50	200	350	25	75
McKinley St. at Sunfish Lake Blvd	EB	0	0	35	35	0	0	33	33	0	0	-2	-2	-6%	0	0	0	9	A	A	A	9	A	4	A		25	50		25	50		25	75
	WB	40	5	16	61	40	6	14	60	0	1	-2	-1	-2%	0	35	33	21	D	D	C	31	D				25	125	75	25	125		25	150
Stop Controlled	NB	72	410	131	613	76	430	144	650	4	20	13	37	6%	1	7	2	2	A	A	A	3	A			125	25	100		25	25	175	25	50
	SB	42	492	0	534	46	543	0	589	4	51	0	55	10%	2	15	0	0	C	A	A	2	A			325	25	100		25	50	325	25	50
TH 10 at Sunfish Lake Blvd	EB	110	2749	45	2904	108	2619	44	2771	-2	-130	-1	-133	-5%	2	147	100	96	F	F	F	101	F	86	F	750	75	325		4975	6100	250	25	50
	WB	38	1372	454	1864	42	1417	474	1933	4	45	20	69	4%	2	122	45	16	F	D	B	39	D			700	50	200		300	1800	675	50	875
Signalized Intersection	NB	43	49	153	245	40	68	170	278	-3	19	17	33	13%	2	244	310	222	F	F	F	247	F			150	75	525		200	575	175	350	600
	SB	526	20	118	664	481	20	113	614	-45	0	-5	-50	-8%	2	101	78	34	F	E	C	88	F			675	175	525		25	175	225	25	225
Riverdale Dr at Sunfish Lake Blvd	EB	235	16		251	251	20		271	16	4	0	20	8%	1	174	160		F	F	A	173	F	126	F		350	550		350	525			
	WB		0	10	10		0	10	10	0	0	0	0	0%	0		0	42	A	A	E	42	E							0	0		0	0
Stop Controlled	SB	20		83	103	27		80	107	7	0	-3	4	4%	0	18		13	C	A	B	14	B				25	175					25	175

Table A6. 2045 No Build PM Peak Hour
4:15-5:15pm

Location	Aprch	Demand volumes				Modeled Volumes				Model - Demand					GEH	Total Delay by Movement (sec/veh)			Level of Service by Movement			LOS by Approach		LOS		Traffic Queuing (feet)								
																										Left Turn			Through Queue			Right Turn		
		L	T	R	Total	L	T	R	total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Jarvis St	EB	29	1945	98	2072	18	907	63	988	-11	-1038	-35	-1084	-52%	28	425	17	20	F	C	C	24	C	82	F	250	75	200		900	1825	225	900	1825
Stop Controlled	WB	49	2423	55	2527	1	1358	63	1422	-48	-1065	8	-1105	-44%	25	681	119	20	F	F	C	124	F			300	750	1175		1750	2450	250	900	1825
	NB	144	18	115	277	1	0	0	1	-143	-18	-115	-276	-100%	23	1773	0	726	F	A	F	1773	F				975	1000		975	1000		1000	1000
	SB	65	18	29	112	1	0	0	1	-64	-18	-29	-111	-99%	15	1937	0	0	F	A	A	1937	F				1025	1625		1025	1625		1025	1625
TH 10 at Alpine Dr	EB	226	2060		2286	39	724		763	-187	-1336	0	-1523	-67%	39	137	45		F	E		50	E	170	F	375	2000	3075		1550	2525		0	0
Stop Controlled	WB		2461	145	2606		1500	87	1587	0	-961	-58	-1019	-39%	22		222	248		F	F	224	F				0	0		4650	10325	275	25	25
	SB	96		106	202	2		16	18	-94	0	-90	-184	-91%	18	154		171	F		F	169	F			225	675	850		0	0	225	675	850
Armstrong Blvd at Alpine Dr	EB	26	142	112	280	16	94	82	192	-10	-48	-30	-88	-31%	6	747	706	678	F	F	F	697	F	115	F		1600	2675		1600	2675		1625	2700
Stop Controlled	WB	29	77	22	128	24	79	20	123	-5	2	-2	-5	-4%	0	294	215	215	F	F	F	13	B				200	550		200	550		200	550
	NB	300	615	100	1015	290	607	100	997	-10	-8	0	-18	-2%	1	14	13	9	B	B	A	231	F				25	525		25	100	275	25	100
	SB	12	190	12	214	11	188	17	216	-1	-2	5	2	1%	0	9	1	0	A	A	A	1	A				25	100		0	0	250	0	0
Armstrong Blvd at Bunker Lake Blvd	EB	5	15	30	50	6	13	30	49	1	-2	0	-1	-2%	0	46	39	2	D	D	A	17	B	20	B	300	25	50		25	100	300	25	50
Signalized Intersection	WB	261	64	673	998	259	15	669	943	-2	-49	-4	-55	-6%	2	34	33	16	C	C	B	21	C			225	50	200		25	50	300	75	525
	NB	25	421	288	734	19	328	219	566	-6	-93	-69	-168	-23%	7	57	25	11	E	C	B	20	C			325	25	75		25	175	285	25	175
	SB	115	176	40	331	98	164	40	302	-17	-12	0	-29	-9%	2	46	1	1	D	A	A	16	B			300	50	225		0	0	300	0	0
147th St at Armstrong Blvd	EB	16	10	30	56	15	10	30	55	-1	0	0	-1	-2%	0	30	33	9	C	C	A	19	B	15	B	200	25	50		25	50	200	25	75
Signalized Intersection	WB	200	10	152	362	200	10	148	358	0	0	-4	-4	-1%	0	21	17	21	C	B	C	21	C			275	25	125		25	50	275	25	200
	NB	25	566	225	816	16	406	170	592	-9	-160	-55	-224	-27%	8	30	13	6	C	B	A	12	B			300	25	75		25	175	300	25	125
	SB	89	370	8	467	76	372	8	456	-13	2	0	-11	-2%	1	29	12	4	C	B	A	15	B			350	25	150		25	200	175	25	50
WB TH 10 Ramps at Armstrong Blvd	WB	205		271	476	153		194	347	-52	0	-77	-129	-27%	6	40		12	D	A	B	24	C	17	B	600	50	250		0	0	600	25	100
Signalized Intersection	NB	215	545		760	170	397		567	-45	-148	0	-193	-25%	7	32	5		C	A	A	13	B			350	50	225		50	225		0	0
	SB		300	300	600		289	309	598	0	-11	9	-2	0%	0		18	13	A	B	B	16	B				0	0		25	175	250	25	300
EB TH 10 Ramps at Armstrong Blvd	EB	306	82	37	425	117	27	8	152	-189	-55	-29	-273	-64%	16	744	602	412	F	F	F	251	F	95	F	225	1000	2700		25	100	225	25	50
Stop Controlled	WB	10	26	152	188	9	26	150	185	-1	0	-2	-3	-2%	0	30	22	7	D	C	A	4	A			200	25	50		25	100	225	0	0
	NB	61	302	20	383	59	299	22	380	-2	-3	2	-3	-1%	0	6	0	1	A	A	A	3	A			275	25	100		0	0	275	0	0
	SB	81	288	158	527	97	161	185	443	16	-127	27	-84	-16%	4	1	2	2	A	A	A	4	A				0	0		0	0		0	0
Bunker Lake Blvd at Ramsey Blvd	EB	79	145	18	242	76	141	20	237	-3	-4	2	-5	-2%	0	36	23	6	D	C	A	26	C	23	C	285	25	150		25	125	285	25	50
Signalized Intersection	WB	58	405	122	585	54	396	131	581	-4	-9	9	-4	-1%	0	36	27	7	D	C	A	24	C			285	25	150		50	200	285	25	100
	NB	80	316	64	460	71	284	60	415	-9	-32	-4	-45	-10%	2	38	22	6	D	C	A	22	C			785	25	175		25	175	285	25	75
	SB	45	168	34	247	47	164	33	244	2	-4	-1	-3	-1%	0	37	22	7	D	C	A	23	C			285	25	100		25	125	285	25	50
Sunwood Dr at Ramsey Blvd	EB	114	142	260	516	113	131	267	511	-1	-11	7	-5	-1%	0	38	28	7	D	C	A	19	B	27	C	350	50	175		25	175	250	25	150
Signalized Intersection	WB	125	167	36	328	125	170	35	330	0	3	-1	2	1%	0	42	29	28	D	C	C	34	C			225	50	225		50	300		50	300
	NB	137	265	45	447	143	267	46	456	6	2	1	9	2%	0	49	29	19	D	C	B	34	C			700	50	250		25	175	300	25	100
	SB	15	141	66	222	12	149	77	238	-3	8	11	16	7%	1	43	27	6	D	C	A	21	C			300	25	75		25	125	300	25	100
TH 10 at Ramsey Blvd	EB	73	1618	84	1775	58	1150	60	1268	-15	-468	-24	-507	-29%	13	124	31	18	F	C	B	34	C	36	D	575	50	225		75	800	400	25	75
Signalized Intersection	WB	46	2424	438	2908	37	1929	341	2307	-9	-495	-97	-601	-21%	12	79	15	12	E	B	B	16	B			775	25	125		100	1075	275	25	150
	NB	75	55	60	190	76	54	59	189	1	-1	-1	-1	-1%	0	93	125	12	F	F	B	77	E			300	50	125		50	200	225	25	100
	SB	345	43	183	571	312	41	181	534	-33	-2	-2	-37	-6%	2	160	100	49	F	F	D	118	F			1000	25	275		25	325	125	25	325
Bunker Lake Blvd at Sunfish Lake Blvd	EB	57	294	251	602	61	307	240	608	4	13	-11	6	1%	0	35	37	7	C	D	A	25	C	26	C	450	25	125		50	300	300	25	150
Signalized Intersection	WB	130	493	124	747	126	493	120	739	-4	0	-4	-8	-1%	0	32	30	6	C	C	A	27	C			400	25	250		75	350	300	25	100
	NB	103	361	99	563	86	302	84	472	-17	-59	-15	-91	-16%	4	36	27	7	D	C	A	27	C			425	25	225		50	300	325	25	100
	SB	51	196	15	262	55	189	17	261	4	-7	2	-1	0%	0	33	26	6	C	C	A	27	C			400	25	150		25	150	350	25	50
McKinley St. at Sunfish Lake Blvd	EB	35	1	85	121	35	2	82	119	0	1	-3	-2	-2%	0	95	17	109	F	C	F	103	F	192	F		100	450		100	450		100	450
Stop Controlled	WB	125	1	68	194	134	0	52	186	9	-1	-16	-8	-4%	1	1234	0	1239	F	A	F	1235	F				1800	1850	75	1800	1850		1850	1875
	NB	60	435	60	555	55	371	22	448	-5	-64	-38	-107	-19%	5	45	6	5	E	A	A	11	B			125	25	225		25	50	175	25	25
	SB	5	597	5	607	6	544	4	554	1	-53	-1	-53	-9%	2	4	10	1	A	B	A	10	B			325	25	25		25	50	325	25	50
TH 10 at Sunfish Lake Blvd	EB	110	2054	50	2214	86	1651	41	1778	-24	-403	-9	-436	-20%	10	142	25	19	F	C	B	30	C	130	F	750	75	275		125	1100	250	25	50
Signalized Intersection	WB	90	2711	390	3191	76	2232	339	2647	-14	-479	-51	-544	-17%	10	270	207	180	F	F	F	205	F			700	50	275		19150	20225	675	4950	5550
	NB	24	25	56	105	22	23	56	101	-2	-2	0	-4	-4%	0	83	108	26	F	F	C	57	E			150	25	100		25	100	175	25	100
	SB	647	30	188	865	574	25	169	768	-73	-5	-19	-97	-11%	3	120	101	74	F	F	E	109	F			675	475	1325		25	225	225	75	400
Riverdale Dr at Sunfish Lake Blvd	EB	90	11		101	88	11		99	-2	0	0	-2	-2%	0	0	0		A	A	A	0	A	8	A		0	0		0	0		0	0
Stop Controlled	WB		10	15	25		11	15	26	0	1	0	1	4%	0		0	0	A	A	A	0	A				0	0		0	0		0	0
	SB	15		155	170	18		125	143	3	0	-30	-27	-16%	2	14		14	B	A	B	14	B				25	200		0	0		25	200

Ramsey Gateway Highway 10 Project

Future Conditions Traffic Memo

June, 2019

Table of Contents

I. Introduction

This memorandum provides future traffic analysis for the Build conditions in Ramsey with the Highway 10 Corridor Improvements project. The project analysis was focused on the intersections of TH 10 at Ramsey Blvd and Sunfish Lake Blvd, but also included an analysis of TH 10 from Jarvis St to Armstrong Blvd. An initial screening of alternatives for each intersection was completed in CAP-X, followed by a more detailed analysis in Synchro/SimTraffic, HCS 7 and VISSIM. This memorandum also summarizes improvements to Highway 10 access spacing.

II. Sunfish Lake Blvd Traffic Analysis

A. CAP-X Screening

CAP-X is a planning level tool that was used to determine if at grade intersection designs or grade separated interchanges would serve the forecasted traffic. It was used as the first step to determine what could work and how long it would be anticipated to function. CAP-X shows the volume to capacity rate (v/c rate) for various intersection and interchange types. The v/c ratio is the total demand volume entering an intersection divided by the theoretical capacity of the intersection or interchange. A v/c ratio less than 0.85 shows adequate capacity is available and no significant delay or queueing is expected. A v/c ratio at or over 1.00 shows that the intersection is over capacity which would show high delay and problematic queuing issues. A v/c ratio between 0.85 and 1.00 would show some delay and queuing. The alternatives analyzed in CAP-X and the results are detailed below.

1. Existing Geometry

Peak Hour	2045 AM	2045 PM	2035 AM	2035 PM	2025 AM	2025 PM	2017 AM	2017 PM
V/C Ratio	1.20	1.21	1.10	1.11	0.99	1.02	0.90	0.96

2. Six Lane TH 10 Section (*Add EBT and WBT lanes)

Peak Hour	2045 AM	2045 PM	2035 AM	2035 PM	2025 AM	2025 PM
V/C Ratio	0.90	0.91	0.82	0.84	0.74	0.77

3. Partial Grade Separation (Only WB TH 10)

Peak Hour	2045 AM	2045 PM	2035 AM	2035 PM	2025 AM	2025 PM
V/C Ratio	1.20	0.98	1.10	0.88	0.99	0.78

4. Partial Grade Separation (Only EB TH 10)

Peak Hour	2045 AM	2045 PM	2035 AM	2035 PM	2025 AM	2025 PM
V/C Ratio	0.80	1.21	<.80	1.11	<.80	1.02

5. Full Grade Separation

Peak Hour	2045 AM	2045 PM	2035 AM	2035 PM	2025 AM	2025 PM
V/C Ratio	0.49	0.60	<0.49	<0.60	<0.49	<0.60

The CAP-X analysis shows that the existing geometry is already close to capacity with 2017 volumes and would be over capacity in 2025. If an additional through lane was provided along TH 10 in both directions, the intersection is anticipated to operate well through 2035, but operations would start to worsen in 2045. The six-lane section would keep the intersection signalized, which is not desired in the future along TH 10. Additionally, adding lanes does not comply with the MetCouncil TPP guidance provided spot mobility improvements through grade separation appear to provide adequate capacity without adding lane miles to maintain. A 6-lane section would require additional right-of-way for frontage road construction due to a widened TH 10 footprint, and also would create an inconsistent typical section along TH 10 (4 lanes to the east and west of a short 6 lane section). Effects of the lane drops were not studied as part of this effort and could potentially create operational issues by themselves. For these reasons, a 6-lane section was dismissed from further consideration.

Partial grade separation would not operate well in 2025. Full grade separation of TH 10 and Sunfish Lake Blvd is recommended as it is the only option anticipated to operate well through 2045.

B. Detailed Traffic Analysis

1. Synchro/SimTraffic and HCS 7

Based on the CAP-X analysis, various grade separated concepts were evaluated at Sunfish Lake Blvd. The Standard Diamond and Tight Diamond options were dismissed prior to analyzing traffic operations. Operations were analyzed in Synchro/SimTraffic for all options except for the roundabouts. Roundabouts were analyzed using Highway Capacity Software (HCS) 7. Traffic operations were analyzed for the following options:

- Sunfish Overpass with Right-In/Right-Out (Option A)
- Sunfish Overpass with Right-In/Right-Out (Option B)
- SPUI
- Grade Separated Roundabout
- Center Turn
- High-T
- TH 10 Overpass with Right-In/Right-Out & WB Exit Ramp
- TH 10 Overpass with Right-In/Right-Out

The Sunfish Overpass with RI/RO Options A and B grade separate Sunfish Lake Blvd from TH 10 and the railroad. All other options grade separate TH 10 from Sunfish Lake Blvd and have an at-grade railroad crossing. With existing railroad grade separation at Armstrong Blvd and Thurston Ave and railroad grade separation options proposed at Ramsey Blvd, many options were analyzed at Sunfish Lake Blvd that have an at grade railroad crossing to save on cost. **Table 1** shows the traffic operations with each option during the 2045 peak hours.

Table 1. 2045 Build Traffic Operations - Sunfish Lake Blvd

Option	Intersection	Peak Hour	Intersection Delay (1.)		Maximum Delay-LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
								Direction	Average Queue (ft)	Max Queue (ft)
Sunfish Overpass with RI/RO (Option A)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	3	A	7	A	SBL	SBL	50	100
		PM	2	A	6	A	SBL	WBR	25	75
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	3	A	11	B	WBT	EBL	50	75
		PM	3	A	23	C	WBT	EBL	50	75
	N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	2	A	9	A	EBT	WBT	50	75
		PM	3	A	9	A	WBT	WBT	50	100
	Sunfish Lake Blvd & N Frontage Rd *Stop Controlled*	AM	4	A	19	C	WBL	EBT	50	75
		PM	7	A	34	D	WBL	WBL	50	150
Sunfish Overpass with RI/RO (Option B)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	3	A	7	A	SBL	EBL	50	125
		PM	2	A	6	A	SBL	WBR	25	75
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	3	A	15	C	WBT	EBL	50	75
		PM	3	A	18	C	WBT	EBL	50	75
	Sunfish Lake Blvd & N Frontage Rd *Stop Controlled*	AM	3	A	14	B	WBL	WBL	50	100
		PM	6	A	37	E	WBL	WBL	75	225
	WB TH 10 RI/RO & Access Rd *Stop Controlled*	AM	2	A	8	A	SBL	SBR	50	75
		PM	2	A	9	A	SBL	SBR	50	100
	N Frontage Rd & Access Rd *Stop Controlled*	AM	2	A	7	A	EBT	EBR	50	75
		PM	3	A	7	A	EBT	EBR	50	75
SPUI	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	14	B	26	C	SBL	SBL	125	250
		PM	15	B	30	C	WBL	SBL	150	300
Grade Separated Roundabout	Sunfish Lake Blvd at TH 10 Ramps *Roundabout (4.)*	AM	9	A	10	B	NB	SB	-	100
		PM	10	B	12	B	SB	SB	-	150
Center Turn	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	16	B	39	D	EBL	SBT	50	425
		PM	12	B	24	C	EBL	SBT	25	350
High-T	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	7	A	18	B	EBL	SBL	100	200
		PM	8	A	20	C	EBL	SBL	125	225
TH 10 Overpass with RI/RO & WB Exit Ramp	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	3	A	7	A	SBL	SBL	50	100
		PM	2	A	6	A	SBL	WBR	25	75
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	3	A	11	B	WBT	EBL	50	75
		PM	3	A	23	C	WBT	EBL	50	75
	Sunfish Lake Blvd & N Frontage Rd *Roundabout (4.)*	AM	7	A	8	A	SB	SB	-	75
		PM	10	B	14	B	SB	SB	-	150
TH 10 Overpass with RI/RO	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	3	A	7	A	SBL	SBL	50	100
		PM	2	A	6	A	SBL	WBR	25	75
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	3	A	11	B	WBT	EBL	50	75
		PM	3	A	23	C	WBT	EBL	50	75
	N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	2	A	9	A	EBT	WBT	50	75
		PM	3	A	9	A	WBT	WBT	50	100
	Sunfish Lake Blvd & N Frontage Rd *Roundabout (4.)*	AM	8	A	9	A	WB/SB	SB	-	75
		PM	11	B	14	B	SB	SB	-	150

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.
4. Analysis completed in HCS7

Table 1 shows that all options are anticipated to operate acceptably with 2045 Build traffic volumes. The overall intersection delay is LOS A or B for all options during both peak hours. The SPUI was modeled with a dual southbound left turn lane. If modeled with a single lane the movement was found to operate with LOS E. Additionally, the Center Turn option is shown in **Table 1** as a signalized intersection. The only option with queues extending beyond turn lanes as modeled is the Center Turn interchange. Average queues are not given for the roundabouts in **Table 1** as HCS 7 only calculates the maximum queues. **Tables A1** and **A2** in the **Appendix** show the detailed traffic operations and queuing results for all the options.

Figure 1 below shows the total interchange delay for each option in seconds per vehicle.

Figure 1. 2045 Build Total Interchange Delay - Sunfish Lake Blvd

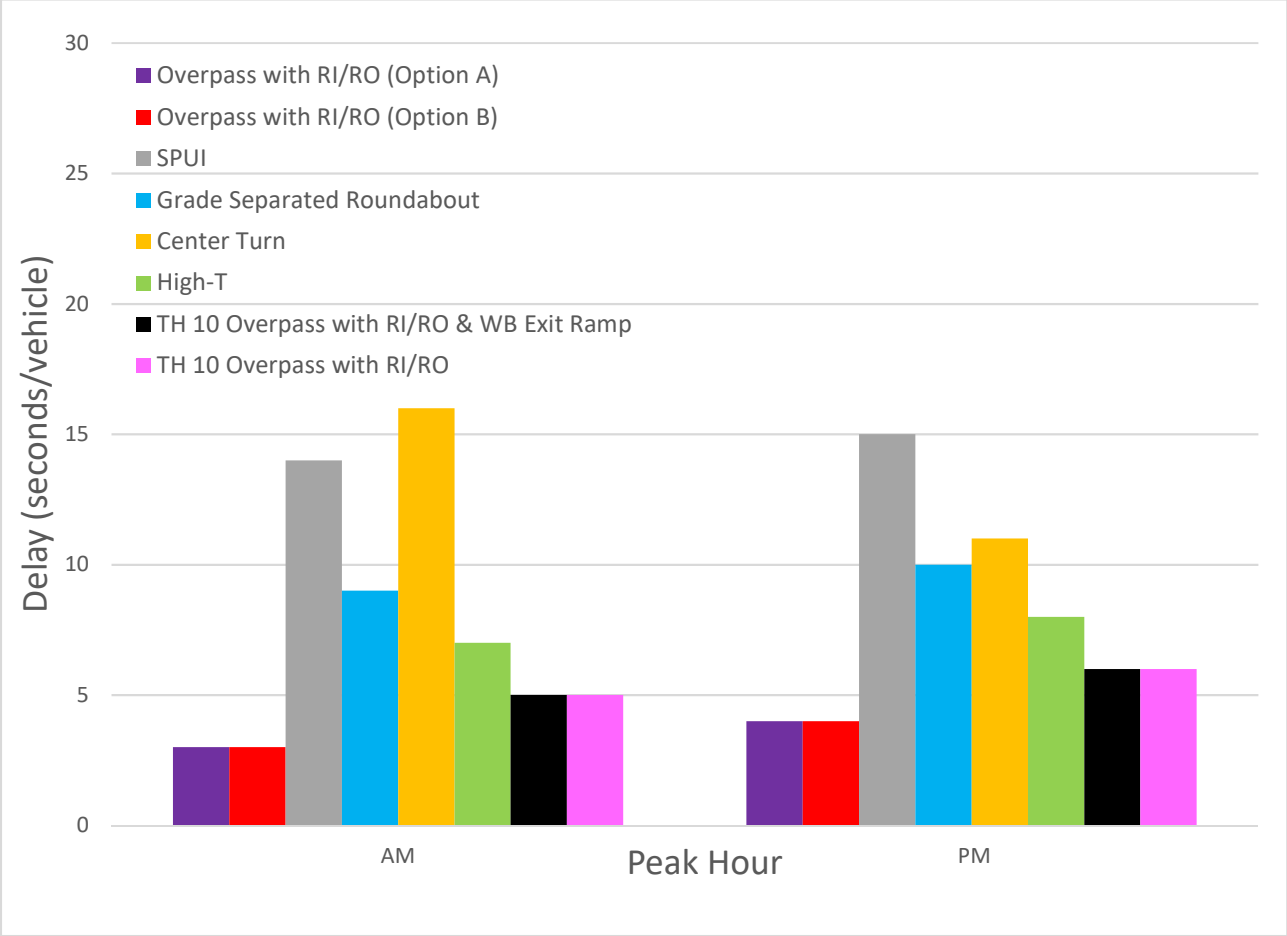


Figure 1 shows that again operations are acceptable for all options, but the Right-In/Right-Out options have the lowest delay per vehicle. The High-T and Grade Separated Roundabouts fall in the middle of the range and the SPUI and Center Turn interchange options have the most delay per vehicle of all the options.

2. VISSIM

The Sunfish Overpass with Right-In/Right-Out (Option A) alternative was analyzed in VISSIM. VISSIM allows the TH 10 traffic to be more accurately modeled with the option to ensure that traffic on the highway would not be disrupted. The results are shown in **Table 2**.

Table 2. 2045 Build Traffic Operations – Sunfish Overpass with Right-In Right Out (Option A)

Intersection	Peak Hour	Intersection Delay (1.)		Maximum Delay-LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	6	A	13	B	EBL	SBL	25	125
	PM	3	A	11	B	SBL	SBL	25	125
Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	9	A	25	D	WBT	SB	25	275
	PM	5	A	16	C	WBT	EBT	25	150
N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	6	A	13	B	EBT	WBT	25	100
	PM	8	A	14	B	EBT/EBR	WB	25	100
Ramsey Blvd & N Frontage Rd *Stop Controlled*	AM	2	A	13	B	WBL	SBT	25	100
	PM	3	A	11	B	WBL	WBL/SBT	25	150

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Table 2 shows that in VISSIM the Right-In/Right-Out operations are shown to be acceptable and there are no queuing issues. The detailed operational analysis is included in **Tables A3** and **A4** of the **Appendix.**

Additionally, a flyover option was analyzed that grade separated TH 10 from Sunfish Lake Blvd, but eliminates access between TH 10 and Sunfish Lake Blvd. Traffic would be re-routed to Thurston Ave and Ramsey Blvd. Without direct access between TH 10 and Sunfish Lake Blvd, the 2045 AADT on the frontage road between Sunfish Lake Blvd to Thurston Avenue is anticipated to be 7,800. With an interchange at TH 10 and Sunfish Lake Blvd, the 2045 AADT for the frontage road is only 2,200 so removing this connection would greatly impact traffic volumes on the frontage road and at TH 10 and Thurston Ave. More details on the traffic forecasting can be found in the "Highway 10 Corridor Improvements Study – Daily Traffic Forecasts" memorandum.

A traffic analysis was completed in VISSIM with the flyover option to determine how the frontage road and TH 10 at Thurston Ave would operate with the added traffic. The analysis was completed with the proposed teardrop roundabout interchange at TH 10 and Thurston and right-in/right-out at the Thurston Ave and Frontage Rd intersection. The 2045 PM peak hour analysis showed that delay and queuing is a major issue along the frontage road. The average vehicle queue is 1450 feet and the maximum queue is 4000 ft. This maximum queue extends nearly the entire length of the frontage road between Thurston Ave and Sunfish Lake Blvd. Additionally, vehicles would wait on average over five minutes to turn right onto Thurston Ave from the frontage road. This shows that

the flyover option would not be able to handle the increase in traffic along the frontage road without direct access between TH 10 and Sunfish Lake Blvd.

3. Warrant Analysis

The traffic analysis completed at TH 10 and Sunfish Lake Blvd showed that a signal was needed with the SPUI and Center Turn alternatives for acceptable operations. A signal warrant analysis was completed to determine if a signal is justified at this location. Traffic signal warrants have been developed as national guidelines to promote continuity of traffic control devices to ensure that traffic signals are installed at intersection that would benefit their use.

The MnMUTCD states that the investigation of the need for a traffic control signal shall include an analysis of the applicable factors contained in the following traffic signal warrants:

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume
- Warrant 3: Peak Hour
- Warrant 4: Pedestrian Volume
- Warrant 5: School Crossing
- Warrant 6: Coordinated Signal System
- Warrant 7: Crash Experience
- Warrant 8: Roadway Network
- Warrant 9: Intersection Near a Grade Crossing

A traffic signal shall not be installed unless one or more of the warrants can be met. Furthermore, a signal shall not be installed unless an engineering study indicates that the signal will improve the overall safety and operation of the intersection.

Forecasted 2025 and 2045 volumes were analyzed. With the major street speed limit exceeding 40 mph, the 70% volume threshold may be used for the warrant analysis. With 2025 volumes only 1 of the required 8 hours are met for Warrant 1A and 4 of the required 8 hours are met for Warrant 1B. With 2045 volumes only 2 of the required 8 hours are met for Warrant 1A and 5 of the required 8 hours are met for Warrant 1B. The results of the signal warrant analysis are documented in the **Appendix**.

C. Safety Analysis

The anticipated reduction in crashes was also calculated for each of the options at Sunfish Lake Blvd to analyze how safety is improved for vehicles. The anticipated reduction in crashes is shown in **Table 3** for each option. For consistency between options, the intersections of Riverdale Dr and N Frontage Rd with Sunfish Lake Blvd were included for each alternative.

Table 3. Crash Reduction – Sunfish Lake Blvd

Option	Anticipated Reduction in Crashes
Sunfish Overpass with RI/RO (Option A)	87%
Sunfish Overpass with RI/RO (Option B)	87%
SPUI	79%
Grade Separated Roundabout	85%
Center Turn	79%
High-T	88%
TH 10 Overpass with RI/RO & WB Exit Ramp	85%
TH 10 Overpass with RI/RO	82%

Table 3 shows that the High-T would have the greatest anticipated reduction in crashes. This is because the High-T option re-routes many movements to other intersections, reducing the traffic volumes at the intersections. The Sunfish Overpass with RI/RO have the next greatest reduction in crashes with an anticipated reduction of 87%. Overall all options effectively reduce crashes, improving the safety of vehicles using this intersection.

III. Ramsey Blvd Traffic Analysis

A. CAP-X Screening

A similar CAP-X screening was completed for Ramsey Blvd and TH 10 as was completed at Sunfish Lake Blvd. The CAP-X results are detailed below. Again, the results with the existing geometry were included as a point of reference.

1. Existing Geometry

Peak Hour	2045 AM	2045 PM	2035 AM	2035 PM	2025 AM	2025 PM	2017 AM	2017 PM
V/C Ratio	1.03	1.00	0.95	0.92	0.87	0.84	0.77	0.76

2. Partial Grade Separation (Only WB TH 10)

Peak Hour	2045 AM	2045 PM	2035 AM	2035 PM	2025 AM	2025 PM
V/C Ratio	1.03	0.73	0.95	<.73	0.87	<.73

3. Partial Grade Separation (Only EB TH1 0)

Peak Hour	2045 AM	2045 PM	2035 AM	2035 PM	2025 AM	2025 PM
V/C Ratio	0.65	1.00	<.65	0.92	<.65	0.84

4. Full Grade Separation

Peak Hour	2045 AM	2045 PM	2035 AM	2035 PM	2025 AM	2025 PM
V/C Ratio	0.46	0.37	<0.46	<0.37	<0.46	<0.37

The results with the existing geometry were included as a point of reference as to the v/c ratio with the operations that are present today and how they would worsen overtime. The CAP-X analysis shows that partial grade separation options would not function well past 2035 so full grade separation is recommended.

B. Detailed Traffic Analysis

1. Synchro/SimTraffic

Based on the CAP-X analysis, various grade separated concepts were evaluated at Ramsey Blvd. The following concepts were dismissed prior to analyzing concepts in Synchro/SimTraffic:

- Standard Diamond
- Folded EB Entrance Ramp Tight Diamond
- Folded EB Entrance Ramp & WB Exit Ramp Tight Diamond
- Folded EB Entrance Ramp & Semi-Folded WB Exit Ramp Tight Diamond
- Single Point Urban Interchange (SPUI)

The **Tier 2 Evaluation Memo** details why these options were dismissed.

Operations for the following options were analyzed in Synchro/SimTraffic:

- Tight Diamond
- Folded WB Exit Ramp Tight Diamond
- Overpass with Right-In/Right-Out (Option A)
- Overpass with Right-In/Right-Out (Option B)
- Tight Diamond with West Frontage Rd

Table 4 shows the traffic operations with each option during the 2045 peak hours. Unless signalized, the Overpass with Right-In/Right-Out (Option B) and Folded WB Exit Ramps Tight Diamond options were shown to have excessive delay and queuing at the WB TH 10 Ramps and Ramsey Blvd intersection due to the heavy WB TH 10 to NB Ramsey Blvd movement. Queues are highlighted red that extend past turn lanes or subsequent intersections. All turn lanes were assumed to be 300 feet.

Table 4. 2045 Build Traffic Operations – Ramsey Blvd

Option	Intersection	Peak Hour	Intersection Delay (1.)		Maximum Delay-LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
								Direction	Average Queue (ft)	Max Queue (ft)
Tight Diamond	WB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	5	A	18	C	WBL	WBR	75	200
		PM	5	A	15	C	WBL	WBR	100	175
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	12	B	76	F	EBL	EBL	125	325
		PM	4	A	29	D	EBL	EBL	50	125
Folded WB Exit Ramp Tight Diamond	WB TH 10 Ramps at Ramsey Blvd *Signalized Intersection*	AM	23	C	48	D	WBT	EBT	125	450
		PM	28	C	54	D	NBL	SBT	200	575
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	9	A	30	D	EBL	SBL	100	275
		PM	5	A	18	C	EBL	SBL	75	175
Overpass with RI/RO (Option A)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	4	A	16	C	EBL	SBL	50	125
		PM	2	A	9	A	EBL	SBL	50	75
	Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	5	A	28	D	WBT	WBT	50	125
		PM	4	A	15	C	WBT	WBT	50	75
	N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	2	A	8	A	EBT	EBR	50	75
		PM	3	A	11	B	WBT	EBR	50	100
	Ramsey Blvd & N Frontage Rd *Stop Controlled*	AM	3	A	19	C	WBL	WBR	50	150
		PM	3	A	20	C	WBL	WBR	75	200
Overpass with RI/RO (Option B)	Riverdale Dr & EB RIRO *Stop Controlled*	AM	5	A	23	C	EBL	SBL	50	150
		PM	3	A	8	A	EBL	SBL	50	75
	Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	7	A	26	D	WBT	WBT	50	125
		PM	6	A	17	C	WBT	WBT	50	100
	Ramsey Blvd & WB TH 10 Ramps/N Frontage Rd *Signalized Intersection*	AM	21	C	40	D	WBT	SBT	175	400
		PM	28	C	41	D	WBT	EBT	125	575
Tight Diamond with West Frontage Rd	WB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	5	A	24	C	WBL	WBR	75	125
		PM	6	A	17	C	WBL	WBR	100	225
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	4	A	67	F	EBL	EBL	100	250
		PM	12	B	27	D	EBL	SBL	50	125
	WB Exit Ramp at East Connection *Stop Controlled*	AM	1	A	1	A	SBR	-	-	-
		PM	1	A	2	A	SBR	SBR	25	50
	N Frontage Rd at East Connection *Stop Controlled*	AM	2	A	7	A	EBT	EBT	25	50
		PM	4	A	7	A	EBT	WBT	50	75
	WB Entrance Ramp at West Connection *Stop Controlled*	AM	1	A	1	A	SBR	-	-	-
		PM	1	A	1	A	SBR	-	-	-
	N Frontage Rd at West Connection *Stop Controlled*	AM	4	A	7	A	WBT	EBT	25	50
		PM	5	A	8	A	WBT	WBL	50	50

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Table 4 shows that all options operate with acceptable intersection delay during both peak hours. The delay is the lowest for the Overpass with Right-In/Right-Out (Option A). For this option all intersections are anticipated to operate with LOS A during the peak hours and only one movement is anticipated to operate with LOS D. The Tight Diamond and Tight Diamond with West Frontage Road options show that the EBL movement at the EB TH 10 Ramps and Ramsey Blvd is anticipated to operate with LOS F during the AM peak hour. The maximum EBT queue at the WB TH 10 Ramps extends beyond the modeled length of channelized turn lanes for the Folded WB Exit Ramps Tight Diamond and Overpass with Right-In/Right-Out (Option B) options, but the queue not anticipated to extend onto TH 10. The detailed operational analysis for all options are included in **Tables A5** and **A6** of the **Appendix**.

The delay for all intersections in each option were combined to determine the overall total interchange delay in seconds per vehicle. This is shown in **Figure 2** below.

Figure 2. 2045 Build Total Interchange Delay - Ramsey Blvd

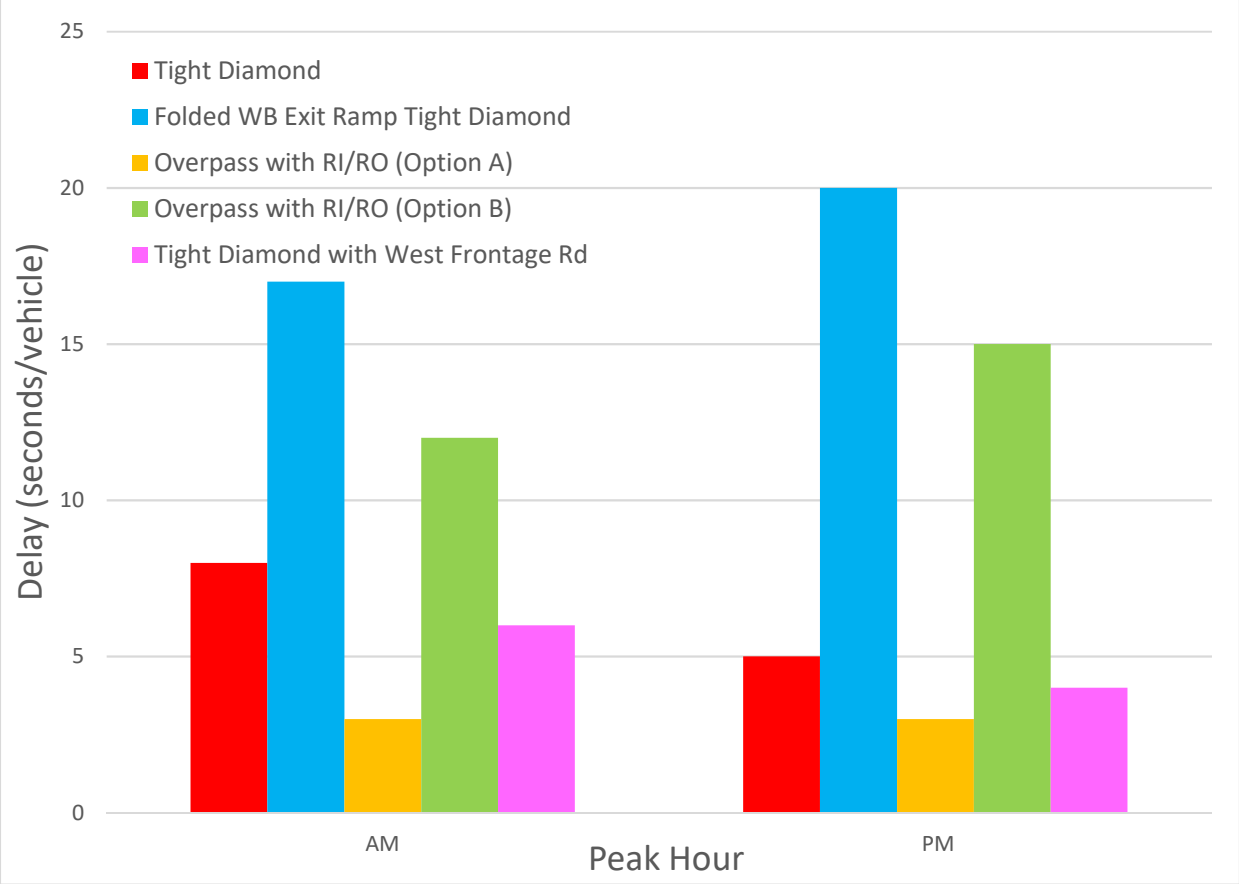


Figure 2 shows that Overpass with Right-In/Right-Out (Option A) has the lowest delay per vehicle overall with three seconds of delay per vehicle during both peak hours. The Overpass with Right-In/Right-Out (Option B) and Folded WB Exit Ramp Tight Diamond options have the greatest delay per vehicle, but operations are still acceptable with LOS C or better.

2. VISSIM

The Overpass with Right-In/Right-Out (Option A) was also analyzed in VISSIM. The results of the VISSIM analysis are shown in **Table 5**.

Table 5. 2045 Build Traffic Operations – Overpass with Right-In Right Out (Option A)

Intersection	Peak Hour	Intersection Delay (1.)		Maximum Delay-LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	6	A	13	B	EBL	SBL	25	125
	PM	3	A	11	B	SBL	SBL	25	125
Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	9	A	25	D	WBT	SB	25	275
	PM	5	A	16	C	WBT	EBT	25	150
N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	6	A	13	B	EBT	WBT	25	100
	PM	8	A	14	B	EBT/EBR	WB	25	100
Ramsey Blvd & N Frontage Rd *Stop Controlled*	AM	2	A	13	B	WBL	SBT	25	100
	PM	3	A	11	B	WBL	WBL/SBT	25	150

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Table 5 shows that in VISSIM operations are very similar to what was found in Synchro/SimTraffic. This confirms that this option would function well with minimal delay and no queuing issues affecting TH 10 operations. The detailed operational analysis is included in **Tables A3** and **A4** of the **Appendix.**

3. Warrant Analysis

The traffic analysis completed at TH 10 and Ramsey Blvd showed that a signal was needed for the intersection of WB TH 10 Ramps at Ramsey Blvd with the Overpass with Right-In/Right-Out (Option B) and Folded WB Exit Ramps Tight alternatives. A signal warrant analysis was completed to determine if a signal is justified at this location. Traffic signal warrants have been developed as national guidelines to promote continuity of traffic control devices to ensure that traffic signals are installed at intersection that would benefit their use.

The MnMUTCD states that the investigation of the need for a traffic control signal shall include an analysis of the applicable factors contained in the following traffic signal warrants:

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume
- Warrant 3: Peak Hour
- Warrant 4: Pedestrian Volume
- Warrant 5: School Crossing

- Warrant 6: Coordinated Signal System
- Warrant 7: Crash Experience
- Warrant 8: Roadway Network
- Warrant 9: Intersection Near a Grade Crossing

A traffic signal shall not be installed unless one or more of the warrants can be met. Furthermore, a signal shall not be installed unless an engineering study indicates that the signal will improve the overall safety and operation of the intersection.

With the major street speed limit exceeding 40 mph, the 70% volume threshold may be used for the warrant analysis. With 2025 volumes, Warrant 1A and Warrant 2 are met. The results of the signal warrant analysis are documented in the **Appendix**.

C. Safety Analysis

The anticipated reduction in crashes was calculated to see how safety is improved for vehicles with each alternative. This reduction was calculated by determining the anticipated crash rate for each intersection of the alternatives. The statewide average crash rate was assumed for each intersection, given the drastic change anticipated from existing conditions with any of the proposed alternatives. For traditional signalized and stop controlled intersections these averages are provided in the MnDOT intersection green sheets. For roundabouts, the average crash rates can be found in the MnDOT study, "The Study of the Traffic Safety at Roundabouts in Minnesota". The anticipated reduction in crashes is shown in **Table 6** for each option. For consistency between options, the intersections of Riverdale Dr and N Frontage Rd with Ramsey Blvd were included for each alternative.

Table 6. Crash Reduction – Ramsey Blvd

Option	Anticipated Reduction in Crashes
Tight Diamond	75%
Folded WB Exit Ramp Tight Diamond	71%
Overpass with RI/RO (Option A)	75%
Overpass with RI/RO (Option B)	69%
Tight Diamond with West Frontage Rd	77%

Table 6 shows that all options are anticipated to effectively reduce crashes by grade-separating Ramsey Blvd from TH 10. The Tight Diamond with West Frontage Rd shows the greatest reduction. This option is slightly better than the Tight Diamond as the N Frontage Rd does not directly intersect Ramsey Blvd. Instead traffic along the frontage road would get to Ramsey Blvd via an access road and the WB Exit Ramp.

IV. Highway Access Improvements

A. Primary Intersection Spacing

According to the MnDOT Access Management Manual, Highway 10 is categorized as a Non-Interstate Freeway – Category 1AF. The spacing recommendation for Non-Interstate Freeways is to have interchanges only. The recommended interim spacing between two at grade full movement intersections on AF Highways is one mile.

The existing primary intersection spacing analysis showed that all primary intersections except Jarvis St and Alpine Dr meet the recommended spacing. Since Jarvis St and Alpine Dr do not meet the recommended spacing, only one is recommended to be full access in the future and the other intersection is recommended to have no or partial access.

The Elk River Comprehensive Plan proposes a future connection between Jarvis St and Fillmore St. This connection would change Jarvis St from a city street to a County Road. As a County Road, Jarvis St would change functional classification from Local Road to a Minor Arterial. The City of Ramsey 2030 Comprehensive Plan shows Alpine Drive near TH 10 as a Local Road today and a Minor Collector in the future.

Based on the proposed functional classification of the two roadways, Jarvis St was analyzed as a full access intersection and Alpine Dr was analyzed as a partial access intersection.

B. Secondary Intersection Spacing

There are currently 12 accesses between Armstrong Blvd and Ramsey Blvd, 20 accesses between Ramsey Blvd and Sunfish Lake Blvd, and 19 accesses between Sunfish Lake Blvd and the Ramsey City limits. With full grade separation recommended at Sunfish Lake Blvd and Ramsey Blvd, all of these accesses are recommended to be closed. Frontage roads are recommended to provide access to these parcels where possible.

From Jarvis St to Armstrong Blvd there are a total of 24 accesses. All accesses are recommended to be closed except:

- Alpine Dr: Convert from full to partial or no access
- Bowers Dr: Either convert from full to partial access or close access if frontage road connection to Armstrong Blvd is provided

C. Other Improvements

1. Weigh Station

There is a Highway 10 Weigh Station located between Alpine Dr and Beatty St. The weigh station acceleration and deceleration lanes should be lengthened to meet or come closer to meeting MnDOT design standards. Currently no full lanes are provided along TH 10 for vehicles to accelerate and decelerate, which limits the ability for the weigh station to remain opened during peak travel periods on TH 10 given the difficultly for large vehicles reentering the traffic stream. Also, since the weigh station is placed between eastbound and westbound TH 10,

vehicles must use left entrance and exit ramps to access it. That means there are merging and diverging movements from the "fast lane" without adequate acceleration or deceleration lanes.

2. Rest Area

The rest area is located directly south of the weigh station. Acceleration and deceleration lanes should be added that meet MnDOT design standards. Currently there is an approximately 150 feet turn lane provided for vehicles exiting at the rest area. For vehicles entering onto TH 10 from the rest area they have approximately 450 feet to accelerate before directly merging with TH 10 traffic.

3. Frontage Roads

Alpine to Jarvis Connection/Realignment

With full access recommended at Jarvis St and partial access recommended at Alpine Dr a connecting road is needed to accommodate vehicles along eastbound TH 10 destined for Alpine Dr. Without a connection, traffic would be rerouted to Armstrong Blvd, which is just over two miles from Alpine Dr. Multiple connections were analyzed. Some options realigned Alpine Dr to Jarvis St where others analyzed a connecting road that would T into both Alpine Dr and Jarvis St following the portion of Adams St constructed northeast of Lee's Riverside Auto. The improvement selected will need to retain the quiet zone crossing at the railroad at-grade crossing with Alpine Dr.

South Frontage Rd from Jarvis St to Armstrong Blvd

Adams St, Beatty St, Bowers Dr, and several residential driveways have access directly onto TH 10. A frontage road south of TH 10 was analyzed that would tie into all of these existing accesses and provide them with access to TH 10 at Jarvis St or Armstrong Blvd. As this improvement is likely to be completed in phases, opportunities exist to temporarily maintain partial access at these locations along TH 10 as needed before the frontage road can accommodate all traffic needs. An example of this could be a partial RCUT at Bowers Dr.

V. West End Traffic Analysis

The West End was taken to be Highway 10 from Jarvis St to Armstrong Blvd. Traffic operations for TH 10 at Jarvis St and TH 10 at Bowers St were analyzed.

A. TH 10 at Jarvis St

1. CAP-X Screening

The 2045 peak hour volumes were analyzed in CAP-X for TH 10 at Jarvis St. The analysis was completed assuming left and right turn lanes on all approaches, two through lanes on TH 10 and single through lanes on the side streets. CAP-X assumes the intersection types are signalized. The results are shown in **Table 7**.

Table 7. TH 10 at Jarvis St

Intersection Type	V/C Ratio	
	2045 AM	2045 PM
Conventional	0.96	0.92
Partial Displaced Left Turn	0.88	0.90
Displaced Left Turn	0.82	0.89
Restricted Crossing U-Turn	0.97	0.95
Median U-Turn	0.93	1.00
Partial Median U-Turn	0.89	0.94

Table 7 shows that with the assumed lane configuration the Median U-Turn option would be over capacity in the 2045 PM peak hour. All other options are nearing capacity with 2045 traffic. This shows that dual turn lanes may be needed for better operations. The CAP-X analysis for an interchange showed that the v/c ratio would range from 0.09 to 0.23. A v/c ratio that low indicates that grade separation at this location could be over-building given current volume projections.

2. Detailed Traffic Analysis

A detailed traffic analysis was completed in VISSIM which analyzed TH 10 at Jarvis St as an RCUT and TH 10 at Alpine Dr as a Right-In/Right-Out. With access restricted at TH 10 and Alpine Dr the eastbound left and southbound left movements were displaced to TH 10 and Jarvis St and a future connection between Jarvis St and Alpine Dr was assumed. The results of this analysis with 2025 and 2045 Build traffic volumes are shown in **Tables 8** and **9**.

Table 8. 2025 Build Traffic Operations - TH 10 at Jarvis St

Option	Peak Hour	Intersection Delay (1.)		Maximum Delay-LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
Unsignalized RCUT	AM	5	A	510	F	NBT	NB	75	175
	PM	41	E	963	F	SBT	EBL	525	2100
Signalized RCUT	AM	9	A	172	F	NBL	EBL	25	250
	PM	14	B	188	F	SBT	WBT	50	675

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Table 8 shows that as an unsignalized RCUT delay would be excessive for the side street movements. The limiting movement delay was found to be over eight minutes during the 2025 AM peak hour and over 16 minutes during the 2025 PM peak hour. Additionally, the maximum eastbound left turn queue during the PM peak hour would extend into the through lanes along TH 10. A signalized RCUT would reduce the limiting movement delay to about three minutes per vehicle and would shorten the problematic queues. Note that the RCUT delay is taking into account

the full movement through the intersection. For example, and northbound left turn would then be a northbound right turn followed by an eastbound U-turn.

Table 9. 2045 Build Traffic Operations - TH 10 at Jarvis St

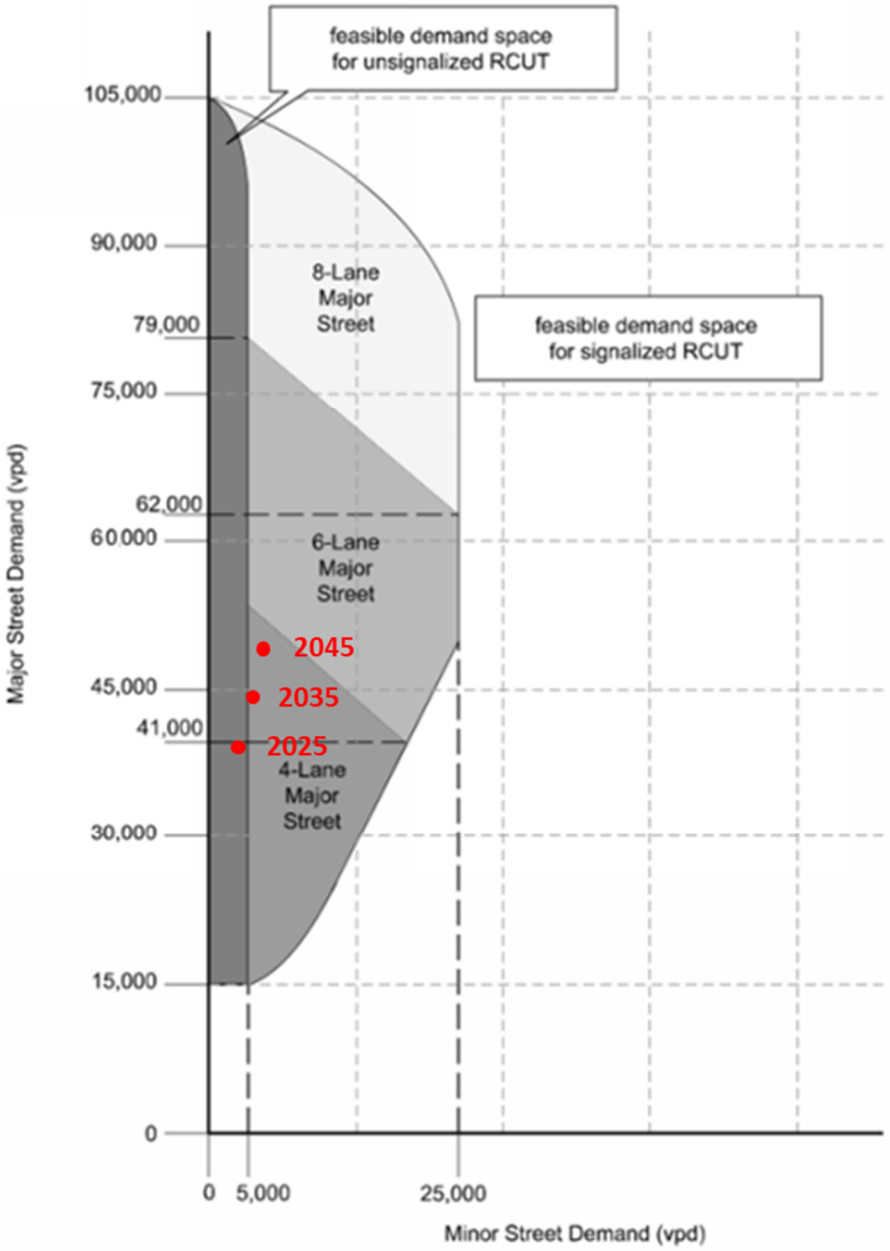
Option	Peak Hour	Intersection Delay (1.)		Maximum Delay-LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
Signalized RCUT	AM	34	C	280	F	NBL	EBT	375	1550
	PM	42	D	341	F	SBT	WBT	325	1450
Signalized RCUT with Dual Turn Lanes	AM	25	C	220	F	NBL	EB	50	725
	PM	30	C	222	F	NBT	WBT	275	1300

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Table 9 shows that with single turn lanes a signalized RCUT, the limiting movements would operate with over four minutes of delay during the AM peak hour and over five minutes during the PM peak hour. If dual NBR, SBR and U-Turns are provided, the limiting movement is reduced by one minute during the AM peak hour and two minutes during the PM peak hour. **Tables A7** and **A8** in the **Appendix** show the detailed traffic operations and queuing results for the RCUT options at TH 10 and Jarvis St.

The MnDOT Technical Memo, "RCUT Design and Implementation Guidelines," contains a graphic which provides guidance on determining when a stop controlled or signalized RCUT is warranted. This graphic is shown in **Figure 3** with the volumes plotted for refence.

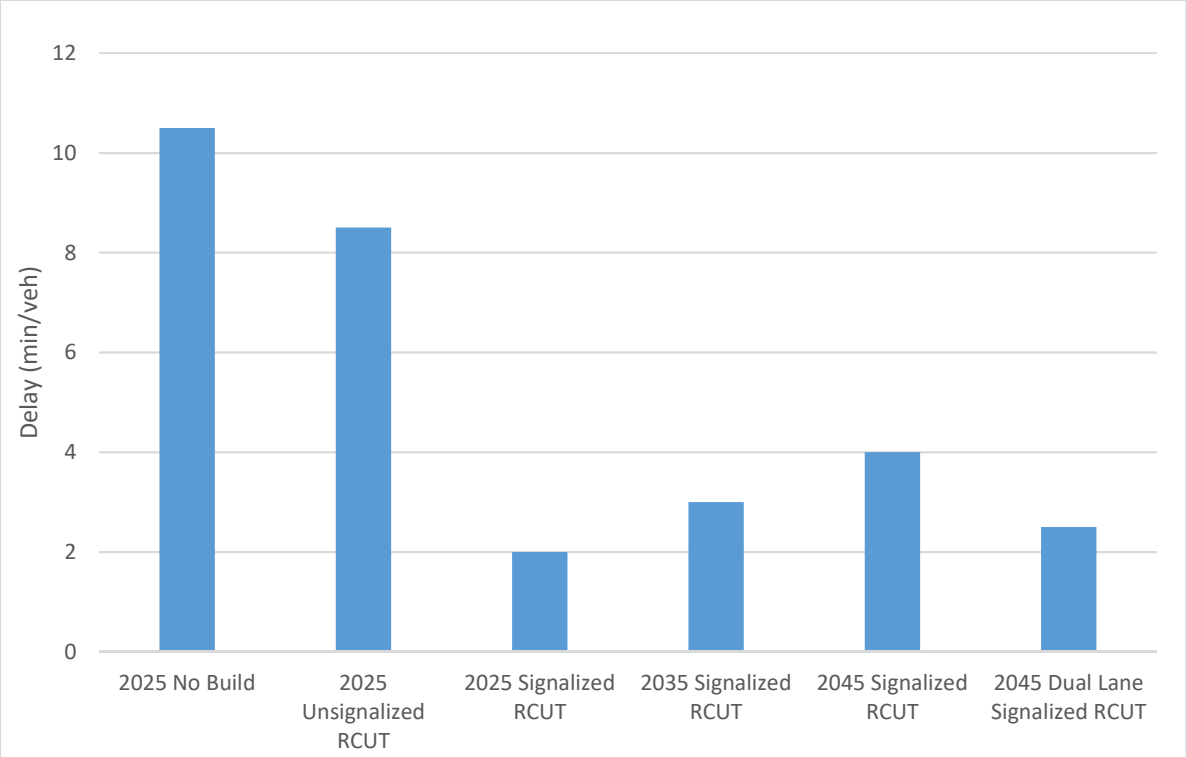
Figure 3. RCUT Planning Capacity



The graphic shows that based on the forecasted volumes a signalized RCUT is not warranted until 2035. The operational analysis, however shows that delay will be excessive for the side streets in 2025 without signalization.

Figure 4 shows the average side street delay in minutes per vehicle during the PM peak hour for various scenarios and build years.

Figure 4. Average Side Street Delay - PM Peak Hour



The modeling for each scenario assumed vehicles would wait for an adequate gap based guidance from AASHTO (American Association of State Highway and Transportation Officials). The existing operational analysis suggested that vehicles are taking shorter gaps due to the lack of gaps in traffic, creating an unsafe environment. The future no build and build analysis was completed assuming vehicles would wait for the design gap. The 2025 PM peak hour no build analysis shows that vehicles from the side streets would have to wait on average over 10 minutes. Vehicles in 2025 with an unsignalized RCUT would wait on average over eight minutes to complete their desired movement. Signalizing the RCUT would reduce the overall wait to two minutes in 2025. Analysis shows that in 2035 PM peak hour delay would increase to three minutes per vehicle for the side streets and four minutes per vehicle by 2045. Adding dual NBR, SBR and U-Turns would reduce the delay to two and a half minutes per vehicle in 2045.

Installing an unsignalized RCUT at this location would be a proactive safety improvement, with little change in operations anticipated.

3. Other Options Analyzed

Overpass with Right-In/Right-Out

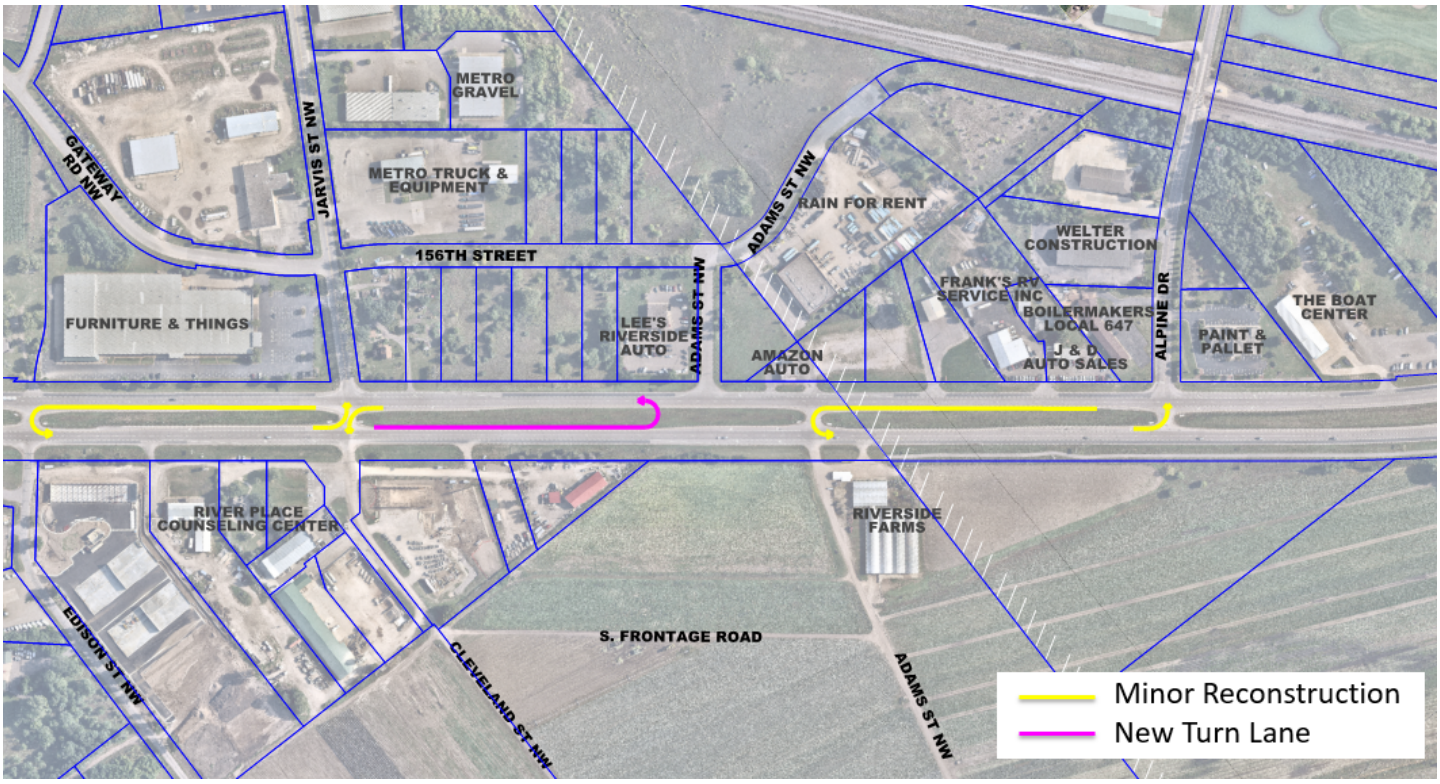
One of the other options analyzed at TH 10 and Jarvis St was an Overpass with Right-In/Right-Out. This option was not analyzed in VISSIM, however since the volumes are lower at this location than

at Ramsey Blvd or Sunfish Lake Blvd it can be assumed that delay and queuing would be minimal. An overpass would be more costly than an RCUT, but would not add traffic signals to TH 10.

Full RCUT at Jarvis St and Partial RCUT at Alpine Dr

Due to the uncertainties of TH 10 in Elk River, it is difficult to reach one recommended solution for TH 10 at Jarvis St and TH 10 at Alpine Dr. A study is needed of TH 10 to TH 101/TH 169 in Elk River to further analyze how these options and possibly others would work with the corridor. With a future study needed, an interim solution was devised to improve safety at a lower cost. The interim solution recommends a RCUT at Jarvis St and a partial RCUT at Alpine Dr. Both RCUTs would be unsignalized. There are many median openings near Jarvis St and Alpine Dr that could be used for the interim solution. **Figure 5** below shows the proposed interim solution. The yellow lines show the locations of current turn lanes and median openings that would need minor reconstruction. The solid pink lines show where a new turn lane and median opening for a U-turn would be needed.

Figure 5. Interim Solution for Jarvis St and Alpine Dr



B. TH 10 at Bowers Dr

1. Detailed Traffic Analysis

An unsignalized partial RCUT was analyzed at the intersection of TH 10 and Bowers Dr. There results of the analysis with 2025 and 2045 Build traffic volumes are shown in **Tables 10** and **11**.

Table 10. 2025 Build Traffic Operations – Partial RCUT at TH 10 & Bowers Dr

Peak Hour	Intersection Delay (1.)		Maximum Delay-LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
						Direction	Average Queue (ft)	Max Queue (ft)
AM	2	A	31	D	WBL	WBL	25	50
PM	4	A	34	D	WBL	WBL	25	50

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Table 11. 2045 Build Traffic Operations - Partial RCUT at TH 10 & Bowers Dr

Peak Hour	Intersection Delay (1.)		Maximum Delay-LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
						Direction	Average Queue (ft)	Max Queue (ft)
AM	4	A	65	F	WBL	EBR	25	150
PM	2	A	44	E	WBL	WBL	25	75

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Tables 10 and **11** show that an unsignalized partial RCUT would operate well in 2025 with all movements operating with LOS D or better. In the 2045 AM peak hour the WBL movement would operate with just over one minute of delay. All other movements operate with acceptable delay. No queues are anticipated to back up beyond turn lanes. **Tables A9** and **A10** in the **Appendix** show the detailed traffic operations and queuing results for the partial RCUT options at TH 10 and Bowers Dr.

C. Safety Analysis

RCUTs greatly improve the safety of intersections. The number of vehicle conflict points is significantly lower with an RCUT than a conventional intersection. At TH 10 and Jarvis St, the existing number of conflict points is 40. With an RCUT the number of conflict points is reduced to 16. Additionally, RCUTs reduce the likelihood crashes, especially severe crashes. The MnDOT technical memorandum on RCUTs states that the 2016 MnDOT study, “A Study of the Traffic Safety at Reduced Conflict Intersections in Minnesota,” found 100% reduction of fatal and serious injury right-angle crashes, 77% reduction in all right-angle crashes and a 50% reduction in injury crashes compared to standard intersections.

VI. Conclusion

Sunfish Lake Blvd and Ramsey Blvd Traffic Analysis

The analysis completed shows that grade separation of TH 10 with Ramsey Blvd and Sunfish Lake Blvd is needed for delay and queuing to be acceptable. Of the grade separated options analyzed, the Overpass with Right-In/Right-Out options were found to have the lowest delay at both locations. All options, however, are anticipated to operate acceptably with 2045 volumes. The anticipated crash reduction at Ramsey Blvd with the alternatives analyzed is between 69% and 77%. At Sunfish Lake Blvd, with the options analyzed, the anticipated crash reduction was found to be between 79% and 88%.

Highway Access Improvements

All accesses between Armstrong Blvd and Ramsey Blvd, Ramsey Blvd to Sunfish Lake Blvd, and Sunfish Lake Blvd to the City limits are recommended to be closed to meet the recommended spacing of interchanges only for Highway 10. This is the recommendation for Non-Interstate Freeways according to the MnDOT Access Management Manual.

All accesses are recommended to be closed from Jarvis St to Armstrong Blvd except Alpine Dr and Bowers Dr. Partial or no access is recommended at Alpine Dr. At Bowers Dr, the access is recommended to be closed only with completion of a frontage road from Bowers Dr to Armstrong Blvd; otherwise a partial RCUT is recommended.

West End Traffic Analysis

The traffic analysis completed at TH 10 and Jarvis St showed that an unsignalized RCUT would operate with excessive limiting movement delay of eight to 16 minutes during the 2025 peak hours. A signalized RCUT would reduce this delay between 60% and 80% during the peak hours while also minimizing queues. By 2045, the limiting movement delay for a signalized RCUT is anticipated to increase to five to six minutes of delay, but delay could be reduced by adding dual turn lanes.

Due to the uncertainties of TH 10 in Elk River a final solution for TH 10 at Jarvis St or Alpine Dr was not reached, however an interim solution of unsignalized RCUTs at Jarvis St and Alpine Dr is recommended to improve vehicular safety.

Appendix

Table A1: 2045 Build Traffic Operations Analysis - Sunfish Lake Blvd

Option	Intersection	Peak Hour	Intersection Delay (1.)		Movement Delay (sec/veh)																							
					NBL		NBT		NBR		SBL		SBT		SBR		EBL		EBT		EBR		WBL		WBT		WBR	
Sunfish Overpass with RI/RO (Option A)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	3	A	-		-		-		7	A	-		3	A	5	A	0	A	-		-		1	A	2	A
		PM	2	A	-		-		-		6	A	-		3	A	5	A	0	A	-		-		1	A	2	A
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	3	A	-		-		-		0	A	-		2	A	5	A	6	A	-		-		11	B	3	A
		PM	3	A	-		-		-		1	A	-		2	A	6	A	6	A	-		-		23	C	3	A
	N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	2	A	1	A	-		0	A	-		-		-		-		9	A	4	A	6	A	8	A	-	
		PM	3	A	1	A	-		0	A	-		-		-		-		8	A	4	A	6	A	9	A	-	
	Sunfish Lake Blvd & N Frontage Rd *Stop Controlled*	AM	4	A	6	A	1	A	1	A	2	A	2	A	0	A	14	B	18	C	6	A	19	C	13	B	2	A
		PM	7	A	9	A	1	A	1	A	2	A	2	A	0	A	27	D	29	D	10	B	34	D	23	C	2	A
Sunfish Overpass with RI/RO (Option B)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	3	A	-		-		-		7	A	-		3	A	5	A	0	A	-		-		1	A	2	A
		PM	2	A	-		-		-		6	A	-		3	A	5	A	0	A	-		-		1	A	2	A
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	3	A	-		-		-		0	A	-		2	A	5	A	6	A	-		-		15	C	3	A
		PM	3	A	-		-		-		1	A	-		2	A	5	A	6	A	-		-		18	C	3	A
	Sunfish Lake Blvd & N Frontage Rd *Stop Controlled*	AM	3	A	-		1	A	1	A	2	A	2	A	-		-		-		-		14	B	-		2	A
		PM	6	A	-		1	A	1	A	3	A	2	A	-		-		-		-		37	E	-		2	A
	WB TH 10 RI/RO & Access Rd *Stop Controlled*	AM	2	A	-		-		-		8	A	-		5	A	4	A	0	A	-		-		1	A	0	A
		PM	2	A	-		-		-		9	A	-		5	A	4	A	0	A	-		-		1	A	0	A
	N Frontage Rd & Access Rd *Stop Controlled*	AM	2	A	0	A	-		0	A	-		-		-		-		7	A	4	A	5	A	6	A	-	
		PM	3	A	0	A	-		0	A	-		-		-		-		7	A	4	A	6	A	6	A	-	
SPUI (Single SBL)	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	15	B	22	C	26	C	3	A	27	C	6	A	3	A	30	C	-		1	A	27	C	-		4	A
		PM	35	D	31	C	23	C	2	A	64	E	23	C	18	B	31	C	-		1	A	27	C	-		2	A
SPUI (Dual SBL)	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	14	B	18	B	16	B	3	A	26	C	6	A	2	A	23	C	-		1	A	26	C	-		6	A
		PM	15	B	24	C	24	C	2	A	23	C	6	A	3	A	30	C	-		1	A	30	C	-		2	A
Grade Separated Roundabout	Sunfish Lake Blvd at TH 10 Ramps *Roundabout (2.)*						NBL/T/R						SBL/T/R						EBL/T/R						WBL/T/R			
		AM	9	A	-		10	B	-		-		9	A	-		-		8	A	-		-		8	A	-	
		PM	10	B	-		8	A	-		-		12	B	-		-		8	A	-		-		7	A	-	
Center Turn	Sunfish Lake Blvd at TH 10 Ramps *Stop Controlled*	AM	22	C	3	A	1	A	1	A	6	A	1	A	1	A	157	F	-		3	A	36	E	-		18	C
		PM	14	B	3	A	1	A	0	A	4	A	1	A	1	A	86	F	-		9	A	52	F	-		7	A
Center Turn	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	16	B	17	B	18	B	7	A	24	C	6	A	4	A	39	D	-		3	A	19	B	-		7	A
		PM	12	B	14	B	14	B	4	A	14	B	5	A	3	A	24	C	-		4	A	20	C	-		6	A
High-T	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	7	A	-		-		2	A	8	A	-		3	A	18	B	-		4	A	-		-		7	A
		PM	8	A	-		-		2	A	10	B	-		4	A	20	C	-		4	A	-		-		7	A
TH 10 Overpass with RI/RO & WB Exit Ramp	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	3	A	-		-		-		7	A	-		3	A	5	A	0	A	-				1	A	2	A
		PM	2	A	-		-		-		6	A	-		3	A	5	A	0	A	-				1	A	2	A
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	3	A	-		-		-		0	A	-		2	A	5	A	6	A	-				11	B	3	A
		PM	3	A	-		-		-		1	A	-		2	A	6	A	6	A	-				23	C	3	A
	Sunfish Lake Blvd & N Frontage Rd *Roundabout (2.)*						NBL/T/R						SBL/T/R										WBL/T/R		WB Exit Ramp			
		AM	7	A	-		4	A	-		-		8	A	-		-		-		-		6	A	8	A	-	
		PM	10	B	-		4	A	-		-		14	B	-		-		-		-		7	A	7	A	-	
TH 10 Overpass with RI/RO	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	3	A	-		-		-		7	A	-		3	A	5	A	0	A	-		-		1	A	2	A
		PM	2	A	-		-		-		6	A	-		3	A	5	A	0	A	-		-		1	A	2	A
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	3	A	-		-		-		0	A	-		2	A	5	A	6	A	-		-		11	B	3	A
		PM	3	A	-		-		-		1	A	-		2	A	6	A	6	A	-		-		23	C	3	A
	N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	2	A	1	A	-		0	A	-		-		-		-		9	A	4	A	6	A	8	A	-	
		PM	3	A	1	A	-		0	A	-		-		-		-		8	A	4	A	6	A	9	A	-	
	Sunfish Lake Blvd & N Frontage Rd *Roundabout (2.)*						NBL/T/R						SBL/T/R						EBL/T/R						WBL/T/R			
		AM	8	A	-		5	A	-		-		9	A	-		-		7	A	-		-		9	A	-	
		PM	11	B	-		5	A	-		-		14	B	-		-		9	A	-		-		10	A	-	

1. Delay in seconds per vehicle
2. Analysis completed in HCS 7

Table A2: 2045 Build Peak Hour Queues By Movement - Sunfish Lake Blvd

Option	Intersection	Peak Hour	Queue Lengths (ft)																							
			EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
			Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Sunfish Overpass with RI/RO (Option A)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	50	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	50	100	-	-	25	50
		PM	25	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	50	75	-	-	25	75
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	50	75	25	75	-	-	-	-	25	50	25	75	-	-	-	-	-	-	-	-	-	-	25	25
		PM	50	75	25	75	-	-	-	-	25	50	25	50	-	-	-	-	-	-	0	25	-	-	25	50
	N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	-	-	25	50	50	75	25	25	50	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		PM	-	-	25	50	50	75	25	50	50	100	-	-	25	25	-	-	-	-	-	-	-	-	-	-
	Sunfish Lake Blvd & N Frontage Rd *Stop Controlled*	AM	25	50	50	75	25	75	25	75	25	75	-	-	25	50	0	25	-	-	25	50	-	-	0	25
		PM	25	75	50	100	25	75	50	150	50	125	-	-	25	50	0	25	25	25	25	75	-	-	25	25
Sunfish Overpass with RI/RO (Option B)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	50	125	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	50	100	-	-	25	50
		PM	25	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	50	50	-	-	25	50
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	50	75	25	75	-	-	-	-	25	50	25	75	-	-	-	-	-	-	-	-	-	-	0	25
		PM	50	75	25	50	-	-	-	-	25	50	25	50	-	-	-	-	-	-	-	-	-	-	25	50
	Sunfish Lake Blvd & N Frontage Rd *Stop Controlled*	AM	-	-	-	-	-	-	50	100	-	-	-	-	-	-	0	25	0	25	25	50	-	-	-	-
		PM	-	-	-	-	-	-	75	225	-	-	25	75	-	-	-	-	0	25	25	75	-	-	-	-
	WB TH 10 RI/RO & Access Rd *Stop Controlled*	AM	25	50	-	-	-	-	-	-	-	-	0	25	-	-	-	-	-	-	50	75	-	-	50	75
		PM	25	50	-	-	-	-	-	-	-	-	0	25	-	-	-	-	-	-	50	75	-	-	50	100
	N Frontage Rd & Access Rd *Stop Controlled*	AM	-	-	25	50	50	75	50	75	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		PM	-	-	25	50	50	75	50	75	25	75	-	-	0	25	-	-	-	-	-	-	-	-	-	-
SPUI (Single SBL)	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	75	150	-	-	-	-	25	125	-	-	25	225	25	50	25	100	-	-	200	350	25	300	-	-
		PM	75	150	-	-	-	-	50	125	-	-	25	125	25	75	25	75	-	-	275	350	325	675	25	75
SPUI (Dual SBL)	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	75	150	-	-	-	-	50	250	-	-	50	250	25	50	25	75	-	-	125	250	25	50	-	-
		PM	75	150	-	-	-	-	50	150	-	-	25	50	25	50	25	75	-	-	150	300	25	175	-	-
Grade Separated Roundabout	Sunfish Lake Blvd at TH 10 Ramps *Roundabout (1.)*				EBL/T/R						WBL/T/R						NBL/T/R						SBL/T/R			
		AM	-	-	-	25	-	-	-	-	-	75	-	-	-	-	-	50	-	-	-	-	-	100	-	-
		PM	-	-	-	25	-	-	-	-	-	50	-	-	-	-	-	25	-	-	-	-	-	150	-	-
Center Turn	Sunfish Lake Blvd at TH 10 Ramps *Stop Controlled*	AM	175	550	-	-	25	75	25	75	-	-	125	300	25	50	-	-	25	50	75	200	-	-	0	25
		PM	100	350	-	-	25	150	75	175	-	-	75	150	25	50	-	-	25	25	50	125	-	-	0	25
Center Turn	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	75	175	-	-	25	50	25	75	-	-	75	175	25	75	25	100	50	125	175	325	50	425	25	75
		PM	75	150	-	-	25	50	50	100	-	-	75	150	25	50	25	75	25	75	150	325	25	350	50	75
High-T	Sunfish Lake Blvd at TH 10 Ramps *Signalized Intersection*	AM	50	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	200	-	-	0	25
		PM	50	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125	225	-	-	-	-
TH 10 Overpass with RI/RO & WB Exit Ramp	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	50	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	50	100	-	-	25	50
		PM	25	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	50	75	-	-	25	75
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	50	75	25	75	-	-	-	-	25	50	25	75	-	-	-	-	-	-	-	-	-	-	25	25
		PM	50	75	25	75	-	-	-	-	25	50	25	50	-	-	-	-	-	-	0	25	-	-	25	50
	Sunfish Lake Blvd & N Frontage Rd *Roundabout (1.)*										WBL/T/R		WB Exit Ramp				NBL/T/R						SBL/T/R			
		AM	-	-	-	-	-	-	-	-	-	25	-	75	-	-	-	25	-	-	-	-	-	75	-	-
		PM	-	-	-	-	-	-	-	-	-	25	-	50	-	-	-	25	-	-	-	-	-	150	-	-
TH 10 Overpass with RI/RO	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	50	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	50	100	-	-	25	50
		PM	25	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	50	75	-	-	25	75
	Sunfish Lake Blvd & Riverdale Dr *Stop Controlled*	AM	50	75	25	75	-	-	-	-	25	50	25	75	-	-	-	-	-	-	-	-	-	-	25	25
		PM	50	75	25	75	-	-	-	-	25	50	25	50	-	-	-	-	-	-	0	25	-	-	25	50
	N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	-	-	25	50	50	75	25	25	50	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		PM	-	-	25	50	50	75	25	50	50	100	-	-	25	25	-	-	-	-	-	-	-	-	-	-
	Sunfish Lake Blvd & N Frontage Rd *Roundabout (1.)*				EBL/T/R						WBL/T/R						NBL/T/R						SBL/T/R			
		AM	-	-	-	25	-	-	-	-	-	75	-	-	-	-	-	25	-	-	-	-	-	75	-	-
		PM	-	-	-	25	-	-	-	-	-	100	-	-	-	-	-	25	-	-	-	-	-	150	-	-

1. Analysis completed in HCS 7

Table A3. 2045 AM - RI/RO Analysis

Location	Aprch	Demand volumes				Modeled Volumes				Model - Demand					Total Delay by Movement (sec/veh)			Level of Service by Movement			LOS by Approach		LOS		Traffic Queuing (feet) Left Turn		Through Queue		Right Turn	
		L	T	R	Total	L	T	R	Total	L	T	R	Total	%	L	T	R	L	T	R	Delay	LOS	Delay	LOS	Avg	Max	Avg	Max	Avg	Max
Ramsey Blvd at N Frontage Rd *Signalized Intersection*	WB	33		418	451	35		413	448	2	0	-5	-3	-1%	10		1	A		A	2	A			25	75			0	0
	NB		181	74	255		181	75	256	0	0	1	1	0%		0	1		A	A	3	A	2	A			0	0	0	0
	SB	70	661		731	66	638		704	-4	-23	0	-27	-4%	4	3		A	A		0	A			25	75	25	150		
N Frontage Rd at WB TH 10 RI/RO (Ramsey) *Stop Controlled*	EB		29	115	144		28	114	142	0	-1	-1	-2	-1%		13	7	A	B	A	5	A					25	75	0	0
	WB	21	22		43	18	25		43	-3	3	0	0	0%	9	12		A	B	A	11	B	6	A	25	75	25	100		
	NB	429		90	519	424		85	509	-5	0	-5	-10	-2%	4		4	A	A	A	4	A			0	0			0	0
Ramsey Blvd at Riverdale Dr *Stop Controlled*	EB	133	114		247	130	106		236	-3	-8		-11	-4%	7	13		A	B	A	10	A			25	125	25	125		
	WB		79	122	201		74	126	200		-5	4	-1	0%		26	7	A	D	A	14	B	9	A			25	125	0	0
	SB	43		651	694	47		621	668	4		-30	-26	-4%	3		8	A	A	A	8	A			25	275			25	275
Riverdale Dr at EB TH 10 RI/RO (Ramsey) *Stop Controlled*	EB	10	24		34	10	23		33		-1	0	-1	-3%	15	0		B	A	A	5	A			25	50	0	0		
	WB		35	695	730		36	655	691		1	-40	-39	-5%		0	4	A	A	A	4	A	6	A			0	0	0	0
	SB	213		10	223	215		11	226	2	0	1	3	1%	10		7	B	A	A	10	A			25	150			25	50
N Frontage Rd at Sunfish Lake Blvd *Stop Controlled*	EB	15	50	50	115	16	50	49	115	1	0	-1	0	0%	9	11	8	A	B	A	10	A			25	75	25	100	25	100
	WB	40	45	385	470	39	45	395	479	-1	0	10	9	2%	9	10	1	A	B	A	3	A	3	A	25	75	25	100	0	0
	NB	15	145	25	185	14	146	25	185	-1	1	0	0	0%	3	0	1	A	A	A	0	A			25	75	0	0	0	0
	SB	70	429	15	514	73	428	13	514	3	-1	-2	0	0%	2	1	1	A	A	A	1	A			25	75	25	25	25	25
N Frontage Rd at WB TH 10 RI/RO (Sunfish) *Stop Controlled*	EB		10	135	145		10	139	149	0	0	4	4	3%		11	6	A	B	A	7	A					25	75	0	0
	WB	5	75		80	6	74		80	1	-1	0	0	0%	8	13		A	B	A	13	B	5	A	25	75	25	125		
	NB	395		29	424	405		31	436	10	0	2	12	3%	3		2	A	A	A	3	A			0	0			0	0
Riverdale Dr at Sunfish Lake Blvd *Stop Controlled*	EB	150	27		177	150	39		189	0	12	0	12	7%	8	8		A	A	A	8	A			25	125	25	100		
	WB		5	35	40		6	35	41	0	1	0	1	3%		12	7	A	B	A	8	A	4	A			25	75	0	0
	SB	18		503	521	502		15	517	484	0	-488	-4	-1%	3		1	A	A	A	3	A			0	0			0	0
Riverdale Dr at EB TH 10 RI/RO (Sunfish) *Stop Controlled*	EB	168	49		217	164	53		217	-4	4	0	0	0%	11	0		B	A	A	8	A			25	150	0	0		
	WB		96	412	508		95	414	509	0	-1	2	1	0%		0	4	A	A	A	3	A	9	A			0	0	0	0
	SB	128		10	138	136		7	143	8	0	-3	5	4%	34		29	D	A	D	34	D			25	125			25	75

Table A4. 2045 PM - RI/RO Analysis

Location	Aprch	Demand volumes				Modeled Volumes				Model - Demand					Total Delay by Movement (sec/veh)			Level of Service by Movement			LOS by Approach		LOS		Traffic Queuing (feet)					
		L	T	R	Total	L	T	R	Total	L	T	R	Total	%	L	T	R	L	T	R	Delay	LOS	Delay	LOS	Left Turn		Through Queue		Right Turn	
																									Avg	Max	Avg	Max	Avg	Max
Ramsey Blvd at N Frontage Rd	WB	85		578	663	76		526	602	-9	0	-52	-61	-9%	11		2	B		A	3	A			25	100			0	0
Signalized Intersection	NB		131	76	207		130	75	205	0	-1	-1	-2	-1%		0	1		A	A	3	A	3	A			0	0	0	0
	SB	133	530		663	154	525		679	21	-5	0	16	2%	6	2		A	A		0	A			25	125	25	125		
N Frontage Rd at WB TH 10 RI/RO (Ramsey)	EB		38	183	221		33	197	230	0	-5	14	9	4%		13	14	A	B	B	14	B					25	75	0	0
	WB	51	36		87	50	34		84	-1	-2	0	-3	-3%	13	11		B	B	A	12	B	8	A	25	100	25	100		
Stop Controlled	NB	627		39	666	568		40	608	-59	0	1	-58	-9%	6		6	A	A	A	6	A			0	0			0	0
Ramsey Blvd at Riverdale Dr	EB	82	82		164	81	79		160	-1	-3		-4	-2%	7	9		A	A	A	8	A			0	0	25	125		
	WB		57	125	182		57	125	182		0	0	0	0%		15	7	A	B	A	9	A	5	A			25	100	0	0
Stop Controlled	SB	55		560	615	56		545	601	1		-15	-14	-2%	2		3	A	A	A	3	A			25	50			0	0
Riverdale Dr at EB TH 10 RI/RO (Ramsey)	EB	5	27		32	5	26		31		-1	0	-1	-3%	4	0		A	A	A	1	A			25	25	0	0		
	WB		66	551	617		60	541	601		-6	-10	-16	-3%		0	1	A	A	A	1	A	3	A			0	0	0	0
Stop Controlled	SB	137		10	147	135		8	143	-2	0	-2	-4	-3%	11		10	B	A	A	11	B			25	125			25	50
N Frontage Rd at Sunfish Lake Blvd	EB	15	50	50	115	16	50	49	115	1	0	-1	0	0%	10	13	8	B	B	A	11	B			25	75	25	100	25	100
	WB	94	100	335	529	93	98	329	520	-1	-2	-6	-9	-2%	11	11	1	B	B	A	5	A	3	A	25	100	25	125	0	0
Stop Controlled	NB	15	120	25	160	16	120	23	159	1	0	-2	-1	-1%	3	0	1	A	A	A	0	A			25	50	0	0	0	0
	SB	140	520	15	675	144	515	11	670	4	-5	-4	-5	-1%	2	1	1	A	A	A	1	A			25	75	25	25	25	25
N Frontage Rd at WB TH 10 RI/RO (Sunfish)	EB		25	188	213		26	191	217	0	1	3	4	2%		12	7	A	B	A	8	A					25	75	0	0
	WB	0	141		141	0	141		141	0	0	0	0	0%	0	16		A	C	A	16	C	7	A	0	0	25	175		
Stop Controlled	NB	389		0	389	376		0	376	-13	0	0	-13	-3%	3		0	A	A	A	3	A			0	0			0	0
Riverdale Dr at Sunfish Lake Blvd	EB	142	10		152	140	24		164	-2	14	0	12	8%	7	8		A	A	A	7	A			25	125	25	100		
	WB		10	21	31		12	20	32	0	2	-1	1	3%		23	6	A	C	A	12	B	4	A			25	75	0	0
Stop Controlled	SB	25		648	673	28		631	659	3	0	-17	-14	-2%	1		3	A	A	A	3	A			0	0			0	0
Riverdale Dr at EB TH 10 RI/RO (Sunfish) *Stop*	EB	56	50		106	55	50		105	-1	0	0	-1	-1%	11	0		B	A	A	6	A			25	75	0	0		
	WB		163	495	658		154	487	641	0	-9	-8	-17	-3%		0	3	A	A	A	3	A	4	A			0	0	0	0
Controlled	SB	116		0	116	114		0	114	-2	0	0	-2	-2%	11		0	B	A	A	11	B			25	100			0	0

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SIGNAL WARRANTS ANALYSIS FOR

Sunfish Lake Blvd at TH 10 Ramps

2025 BUILD

LOCATION: Sunfish Lake Blvd at TH 10 Ramps
COUNTY: Anoka
REF. POINT:
DATE: 1/29/2019
OPERATOR: KR

Speed	Approach Description		Lanes
45	Major App1:	NORTHBOUND	2
45	Major App3:	WESTBOUND	1
45	Minor App2:	SOUTHBOUND	3
45	Minor App4:	EASTBOUND	1

0.70 FACTOR USED? YES
POPULATION < 10,000? No
N/A No

THRESHOLDS 1A/1B: 420/630 140/70 105/52

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 (	**MET SAME 1A/1B**
0:00 - 1:00			0	/		/		/	**/**
1:00 - 2:00			0	/		/		/	**/**
2:00 - 3:00			0	/		/		/	**/**
3:00 - 4:00			0	/		/		/	**/**
4:00 - 5:00			0	/		/		/	**/**
5:00 - 6:00			0	/		/		/	**/**
6:00 - 7:00	95	520	615	X/	15	/	110	X/X	**X/**
7:00 - 8:00	175	645	820	X/X	20	/	100	/X	**/X**
8:00 - 9:00	80	410	490	X/	45	/	70	/X	**/**
9:00 - 10:00	45	360	405	/	35	/	60	/X	**/**
10:00 - 11:00	65	320	385	/	30	/	55	/X	**/**
11:00 - 12:00	80	435	515	X/	35	/	70	/X	**/**
12:00 - 13:00	75	415	490	X/	45	/	60	/X	**/**
13:00 - 14:00	70	360	430	X/	50	/	65	/X	**/**
14:00 - 15:00	70	460	530	X/	65	/	65	/X	**/**
15:00 - 16:00	65	695	760	X/X	45	/	80	/X	**/X**
16:00 - 17:00	75	735	810	X/X	45	/	95	/X	**/X**
17:00 - 18:00	60	625	685	X/X	45	/	75	/X	**/X**
18:00 - 19:00	45	340	385	/	45	/	60	/X	**/**
19:00 - 20:00			0	/		/		/	**/**
20:00 - 21:00			0	/		/		/	**/**
21:00 - 22:00			0	/		/		/	**/**
22:00 - 23:00			0	/		/		/	**/**
23:00 - 24:00			0	/		/		/	**/**

	Met (Hr)	Required (Hr)	
Warrant 1A	1	8	Not satisfied
Warrant 1B	4	8	Not satisfied
Warrant 2	1	4	Not satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	7	8	Not satisfied

LOCATION: Sunfish Lake Blvd at TH 10 Ramps
COUNTY: Anoka
REF. POINT:
DATE: 1/29/2019
OPERATOR: KR

Speed	Approach Description	Lanes
45	Major App1: NORTHBOUND	2
45	Major App3: WESTBOUND	1
45	Minor App2: SOUTHBOUND	3
45	Minor App4: EASTBOUND	1

0.70 FACTOR USED? YES
POPULATION < 10,000? No
EXISTING SIGNAL ? No

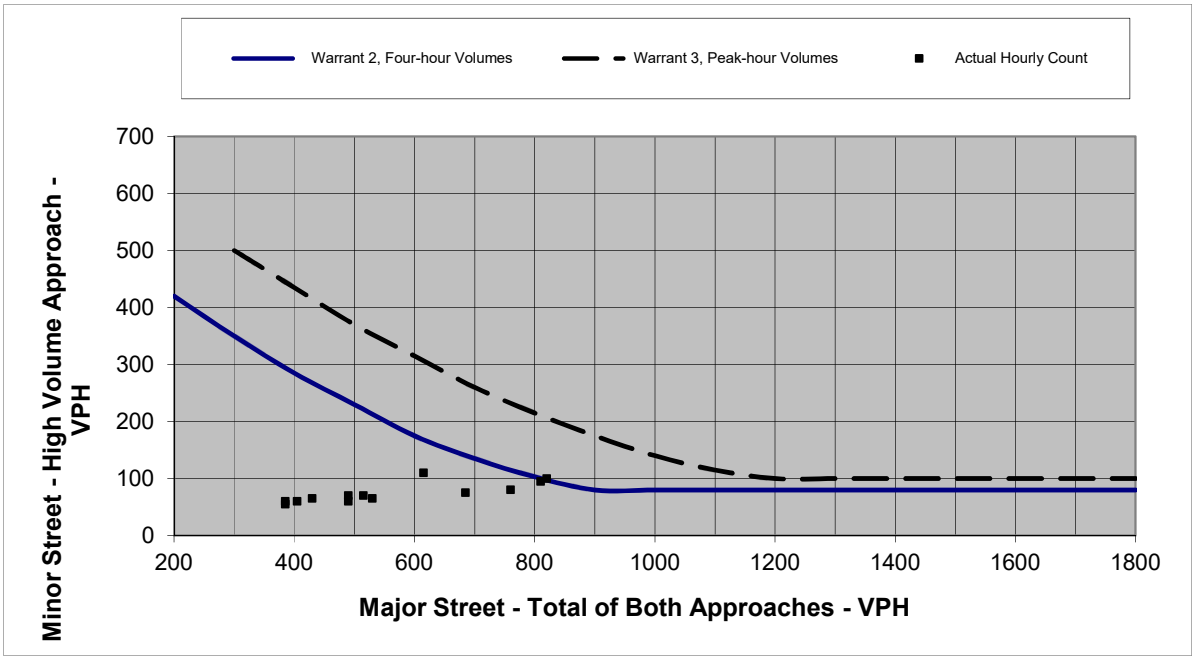

Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, F	Warrant 3, Pe	Major	Actual Hourly Count
200	420		0	0
300	350	500	0	0
400	285	435	0	0
500	230	370	0	0
600	175	315	0	0
700	135	260	0	0
800	103	215	615	110
900	80	175	820	100
1000	80	140	490	70
1100	80	115	405	60
1200	80	100	385	55
1300	80	100	515	70
1400	80	100	490	60
1500	80	100	430	65
1600	80	100	530	65
1700	80	100	760	80
1800	80	100	810	95
			685	75
			385	60
			0	0
			0	0
			0	0
			0	0
			0	0

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SIGNAL WARRANTS ANALYSIS FOR

Sunfish Lake Blvd at TH 10 Ramps

2045 BUILD

LOCATION: Sunfish Lake Blvd at TH 10 Ramps
COUNTY: Anoka
REF. POINT:
DATE: 1/29/2019
OPERATOR: KR

Speed	Approach Description		Lanes
45	Major App1:	NORTHBOUND	2
45	Major App3:	WESTBOUND	1
45	Minor App2:	SOUTHBOUND	3
45	Minor App4:	EASTBOUND	1

0.70 FACTOR USED? YES
POPULATION < 10,000? No
N/A No

THRESHOLDS 1A/1B: 420/630 140/70 105/52

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 (	**MET SAME 1A/1B**
0:00 - 1:00			0	/		/		/	**/**
1:00 - 2:00			0	/		/		/	**/**
2:00 - 3:00			0	/		/		/	**/**
3:00 - 4:00			0	/		/		/	**/**
4:00 - 5:00			0	/		/		/	**/**
5:00 - 6:00			0	/		/		/	**/**
6:00 - 7:00	155	545	700	X/X	15	/	120	X/X	**X/X**
7:00 - 8:00	285	680	965	X/X	25	/	110	X/X	**X/X**
8:00 - 9:00	125	430	555	X/	60	/	75	/X	**/**
9:00 - 10:00	75	380	455	X/	45	/	65	/X	**/**
10:00 - 11:00	105	335	440	X/	40	/	60	/X	**/**
11:00 - 12:00	125	465	590	X/	45	/	75	/X	**/**
12:00 - 13:00	120	440	560	X/	55	/	65	/X	**/**
13:00 - 14:00	105	385	490	X/	60	/	70	/X	**/**
14:00 - 15:00	105	485	590	X/	80	/X	70	/X	**/**
15:00 - 16:00	115	740	855	X/X	55	/	85	/X	**/X**
16:00 - 17:00	125	780	905	X/X	55	/	100	/X	**/X**
17:00 - 18:00	85	660	745	X/X	55	/	80	/X	**/X**
18:00 - 19:00	70	360	430	X/	55	/	65	/X	**/**
19:00 - 20:00			0	/		/		/	**/**
20:00 - 21:00			0	/		/		/	**/**
21:00 - 22:00			0	/		/		/	**/**
22:00 - 23:00			0	/		/		/	**/**
23:00 - 24:00			0	/		/		/	**/**

	Met (Hr)	Required (Hr)	
Warrant 1A	2	8	Not satisfied
Warrant 1B	5	8	Not satisfied
Warrant 2	2	4	Not satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	**9**	8	**Satisfied, check accident record**

LOCATION: Sunfish Lake Blvd at TH 10 Ramps
COUNTY: Anoka
REF. POINT:
DATE: 1/29/2019
OPERATOR: KR

Speed	Approach Description	Lanes
45	Major App1: NORTHBOUND	2
45	Major App3: WESTBOUND	1
45	Minor App2: SOUTHBOUND	3
45	Minor App4: EASTBOUND	1

0.70 FACTOR USED? YES
POPULATION < 10,000? No
EXISTING SIGNAL ? No

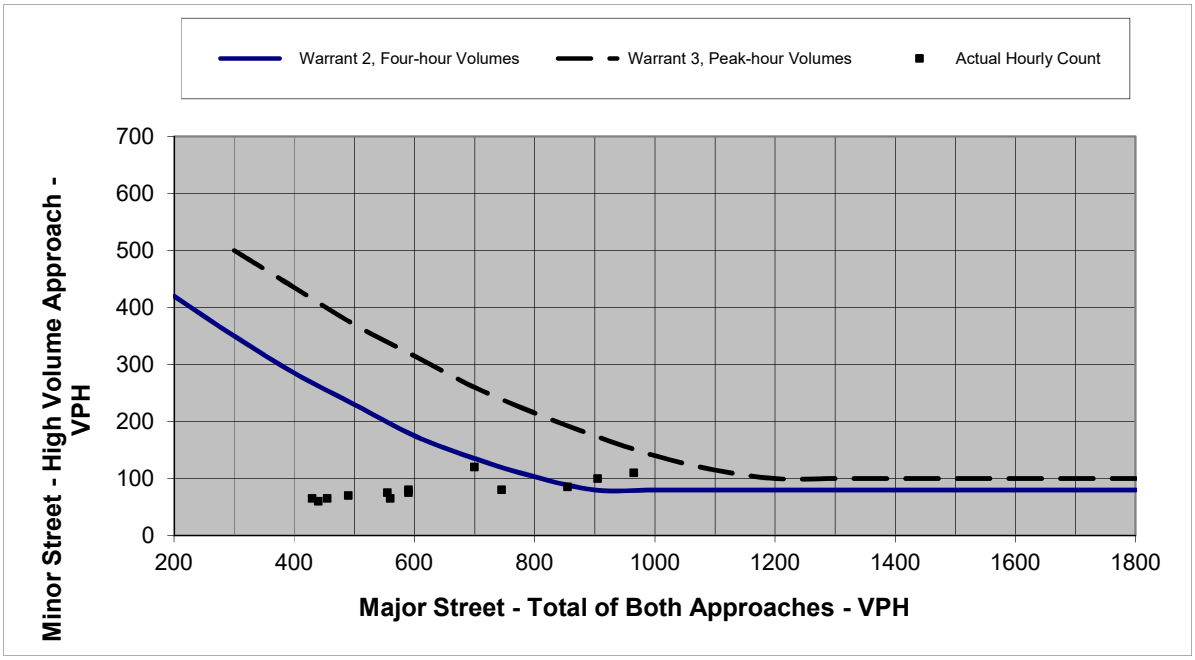


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, F	Warrant 3, Pe	Major	Actual Hourly Count
200	420		0	0
300	350	500	0	0
400	285	435	0	0
500	230	370	0	0
600	175	315	0	0
700	135	260	0	0
800	103	215	700	120
900	80	175	965	110
1000	80	140	555	75
1100	80	115	455	65
1200	80	100	440	60
1300	80	100	590	75
1400	80	100	560	65
1500	80	100	490	70
1600	80	100	590	80
1700	80	100	855	85
1800	80	100	905	100
			745	80
			430	65
			0	0
			0	0
			0	0
			0	0
			0	0

Table A5: 2045 Build Traffic Operations Analysis - Ramsey Blvd

Option	Intersection	Peak Hour	Intersection Delay (1.)		Movement Delay (sec/veh)																							
					NBL		NBT		NBR		SBL		SBT		SBR		EBL		EBT		EBR		WBL		WBT		WBR	
Tight Diamond	WB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	5	A	9	A	1	A	-		-		4	A	0	A	-		-		-		18	C	-		7	A
		PM	5	A	8	A	0	A	-		-		4	A	1	A	-		-		-		15	C	-		8	A
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	12	B	-		1	A	1	A	5	A	0	A	-		76	F	-		4	A	-		-		-	
		PM	4	A	-		1	A	1	A	4	A	0	A	-		29	D	-		4	A	-		-		-	
Folded WB Exit Ramp Tight Diamond	WB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	211	F	12	B	1	A	1	A	2	A	4	A	0	A	803	F	690	F	402	F	24	C	37	E	5	A
		PM	317	F	9	A	1	A	0	A	2	A	4	A	1	A	994	F	886	F	928	F	25	D	43	E	5	A
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	10	B	-		1	A	1	A	5	A	0	A	-		62	F	-		4	A	-		-		-	
		PM	4	A	-		1	A	0	A	4	A	0	A	-		21	C	-		3	A	-		-		-	
Folded WB Exit Ramp Tight Diamond	WB TH 10 Ramps at Ramsey Blvd *Signalized Intersection*	AM	23	C	43	D	10	B	3	A	14	B	19	C	1	A	36	D	27	C	8	A	45	D	48	D	5	A
		PM	28	C	54	D	15	C	3	A	26	D	30	D	3	A	32	C	22	C	12	B	43	D	42	D	5	A
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	9	A	-		1	A	1	A	8	A	1	A	-		30	D	-		3	A	-		-		-	
		PM	5	A	-		1	A	0	A	7	A	1	A	-		18	C	-		3	A	-		-		-	
RIRO (Option 7A)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	4	A	-		-		-		7	A	-		3	A	16	C	0	A	-		-		1	A	3	A
		PM	2	A	-		-		-		6	A	-		2	A	9	A	0	A	-		-		1	A	2	A
	Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	5	A	-		-		-		1	A	-		2	A	7	A	7	A	-		-		28	D	4	A
		PM	4	A	-		-		-		1	A	-		2	A	6	A	7	A	-		-		15	C	4	A
	N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	2	A	1	A	-		0	A	-		-		-		-		8	A	3	A	7	A	8	A	-	
		PM	3	A	1	A	-		0	A	-		-		-		-		10	B	4	A	10	B	11	B	-	
	Ramsey Blvd & N Frontage Rd *Stop Controlled*	AM	3	A	-		1	A	1	A	2	A	2	A	-		-		-		-		19	C	-		3	A
		PM	3	A	-		1	A	1	A	3	A	2	A	-		-		-		-		20	C	-		4	A
RIRO (Option 7B)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	3	A	-		-		-		6	A	-		3	A	15	C	0	A	-		-		1	A	3	A
		PM	3	A	-		-		-		5	A	-		3	A	6	A	0	A	-		-		1	A	2	A
	Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	5	A	-		-		-		1	A	-		2	A	7	A	7	A	-		-		26	D	4	A
		PM	4	A	-		-		-		1	A	-		2	A	6	A	7	A	-		-		14	B	4	A
	Ramsey Blvd & N Frontage Rd *Stop Controlled*	AM	336	F	9	A	1	A	1	A	2	A	2	A	0	A	1047	F	953	F	922	F	28	D	33	D	5	A
		PM	437	F	8	A	1	A	1	A	2	A	2	A	1	A	1239	F	1063	F	1195	F	19	C	29	D	5	A
RIRO (Option 7B)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	5	A	-		-		-		8	A	-		3	A	23	C	0	A	-		-		1	A	4	A
		PM	3	A	-		-		-		6	A	-		3	A	8	A	0	A	-		-		1	A	3	A
	Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	7	A	-		-		-		3	A	2	A	5	A	7	A	8	A	-		-		26	D	4	A
		PM	6	A	-		-		-		3	A	2	A	5	A	6	A	7	A	-		-		17	C	4	A
	Ramsey Blvd & N Frontage Rd *Signalized Intersection*	AM	21	C	19	B	7	A	2	A	13	B	17	B	2	A	39	D	22	C	11	B	39	D	40	D	6	A
		PM	28	C	22	C	13	B	2	A	19	B	26	C	3	A	41	D	17	B	11	B	39	D	41	D	6	A
Tight Diamond with West Frontage Rd	WB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	5	A	9	A	1	A	-		-		4	A	0	A	-		-		-		24	C	-		6	A
		PM	6	A	8	A	0	A	-		-		4	A	1	A	-		-		-		17	C	-		9	A
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	4	A	-		1	A	1	A	5	A	0	A	-		67	F	-		4	A	-		-		-	
		PM	12	B	-		1	A	0	A	4	A	0	A	-		27	D	-		3	A	-		-		-	
	WB Exit Ramp at East Connection *Stop Controlled*	AM	1	A	-		-		-		-		-		1	A	-		-		-		-		1	A	0	A
		PM	1	A	-		-		-		-		-		2	A	-		-		-		-		1	A	0	A
	N Frontage Rd at East Connection *Stop Controlled*	AM	2	A	0	A	-		0	A	-		-		-		-		7	A	4	A	4	A	6	A	-	
		PM	4	A	0	A	-		0	A	-		-		-		-		7	A	3	A	4	A	6	A	-	
	WB Entrance Ramp at West Connection *Stop Controlled*	AM	1	A	-		-		-		-		-		1	A	-		-		-		-		0	A	0	A
		PM	1	A	-		-		-		-		-		1	A	-		-		-		-		0	A	0	A
	N Frontage Rd at West Connection *Stop Controlled*	AM	4	A	0	A	-		0	A	-		-		-		-		6	A	3	A	5	A	7	A	-	
		PM	5	A	0	A	-		0	A	-		-		-		-		6	A	2	A	6	A	8	A	-	

1. Delay in seconds per vehicle

Table A6: 2045 Build Peak Hour Queues By Movement - Ramsey Blvd

Option	Intersection	Peak Hour	Queue Lengths (ft)																					
			EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
			Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Tight Diamond	WB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	-	-	-	-	-	-	25	75	-	-	75	200	25	75	-	-	-	-	-	-	-	-	-	-
		PM	-	-	-	-	-	-	50	75	-	-	100	175	25	75	-	-	-	-	-	-	-	-	25	25
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	125	325	-	-	50	150	-	-	-	-	-	-	-	-	-	-	25	50	75	200	-	-	-	-
		PM	50	125	-	-	50	75	-	-	-	-	-	-	-	-	-	-	25	25	50	125	-	-	-	-
Folded WB Exit Ramp Tight Diamond	WB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	225	225	1900	3500	25	50	25	50	25	75	25	50	25	75	0	25	0	25	25	25	0	25	0	25
		PM	225	225	2825	3550	25	50	25	75	50	125	25	50	25	75	0	25	-	-	25	25	0	25	25	25
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	100	250	-	-	50	75	-	-	-	-	-	-	-	-	-	-	25	50	75	175	-	-	-	-
		PM	50	100	-	-	50	75	-	-	-	-	-	-	-	-	-	-	25	25	50	150	-	-	-	-
Folded WB Exit Ramp Tight Diamond	WB TH 10 Ramps at Ramsey Blvd *Signalized Intersection*	AM	175	225	125	450	25	50	25	50	25	75	25	50	50	125	50	150	25	50	25	50	175	375	25	50
		PM	200	225	200	525	25	100	50	100	50	125	25	50	50	100	50	125	25	25	25	125	200	575	25	75
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	75	175	-	-	50	75	-	-	-	-	-	-	-	-	-	-	25	50	100	275	-	-	-	-
		PM	50	100	-	-	50	75	-	-	-	-	-	-	-	-	0	25	25	50	75	175	-	-	-	-
RIRO (Option 7A)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	50	125	-	-	25	25
		PM	25	50	-	-	-	-	-	-	-	-	25	25	-	-	-	-	-	-	50	75	-	-	25	25
	Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	50	100	50	75	-	-	-	-	50	125	50	75	-	-	-	-	-	-	0	25	-	-	25	50
		PM	50	75	50	75	-	-	-	-	50	75	50	75	-	-	-	-	-	-	0	25	-	-	25	50
	N Frontage Rd & WB TH 10 RI/RO *Stop Controlled*	AM	-	-	25	75	50	75	25	50	25	50	-	-	25	25	-	-	-	-	-	-	-	-	-	-
		PM	-	-	50	75	50	100	50	75	50	75	-	-	25	25	-	-	0	25	-	-	-	-	-	-
	Ramsey Blvd & N Frontage Rd *Stop Controlled*	AM	-	-	-	-	-	-	25	75	-	-	50	150	-	-	-	-	0	25	25	50	-	-	-	-
		PM	-	-	-	-	-	-	50	125	-	-	75	200	-	-	-	-	25	25	25	75	-	-	-	-
RIRO (Option 7B)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	50	100	-	-	25	25
		PM	25	50	-	-	-	-	-	-	-	-	0	25	-	-	-	-	-	-	50	75	-	-	25	25
	Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	50	75	50	75	-	-	-	-	50	125	50	75	-	-	-	-	-	-	25	25	-	-	25	50
		PM	50	75	50	75	-	-	-	-	50	75	50	75	-	-	-	-	-	-	-	-	-	-	25	50
	Ramsey Blvd & N Frontage Rd *Stop Controlled*	AM	350	350	3425	4625	25	75	25	75	25	75	25	50	25	75	-	-	0	25	25	50	-	-	-	-
		PM	350	350	4375	4950	25	75	25	75	50	100	25	50	25	75	0	25	-	-	25	25	0	25	25	25
RIRO (Option 7B)	Riverdale Dr & EB TH 10 RI/RO *Stop Controlled*	AM	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	50	150	-	-	25	25
		PM	25	50	-	-	-	-	-	-	-	-	25	25	-	-	-	-	-	-	50	75	-	-	25	25
	Ramsey Blvd & Riverdale Dr *Stop Controlled*	AM	50	100	50	75	-	-	-	-	50	125	50	100	-	-	-	-	-	-	-	-	-	-	25	50
		PM	50	75	50	75	-	-	-	-	50	100	50	75	-	-	-	-	-	-	-	-	-	-	25	25
	Ramsey Blvd & N Frontage Rd *Signalized Intersection*	AM	200	325	100	375	25	125	25	75	25	75	25	50	25	75	50	125	25	50	25	50	175	400	25	50
		PM	275	350	125	575	25	125	25	75	50	125	25	50	50	100	50	125	25	25	25	50	200	400	25	100
Tight Diamond with West Frontage Rd	WB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	-	-	-	-	-	-	25	75	-	-	75	125	25	75	-	-	-	-	-	-	-	-	0	25
		PM	-	-	-	-	-	-	50	75	-	-	100	225	25	75	-	-	-	-	-	-	-	-	0	25
	EB TH 10 Ramps at Ramsey Blvd *Stop Controlled*	AM	100	250	-	-	50	75	-	-	-	-	-	-	-	-	-	-	25	25	75	150	-	-	-	-
		PM	50	100	-	-	50	75	-	-	-	-	-	-	-	-	-	-	25	25	50	125	-	-	-	-
	WB Exit Ramp at East Connection *Stop Controlled*	AM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		PM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	N Frontage Rd at East Connection *Stop Controlled*	AM	-	-	25	50	25	50	25	50	25	50	-	-	-	-	-	-	0	25	-	-	-	-	-	-
		PM	-	-	25	50	25	50	25	50	50	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WB Entrance Ramp at West Connection *Stop Controlled*	AM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		PM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	N Frontage Rd at West Connection *Stop Controlled*	AM	-	-	25	50	25	50	25	50	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		PM	-	-	25	50	25	50	50	50	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BOLTON & MENK
Real People. Real Solutions.

SIGNAL WARRANTS ANALYSIS FOR Ramsey Blvd at N Frontage Rd-TH 10 WB

2025 BUILD

LOCATION: Ramsey at N Frontage Rd-TH 10 WB
COUNTY: Anoka
REF. POINT:
DATE: 1/29/2019
OPERATOR: KR

Speed	Approach Description		Lanes
45	Major App1:	NORTHBOUND	2
45	Major App3:	SOUTHBOUND	2
45	Minor App2:	WESTBOUND	2
45	Minor App4:	EASTBOUND	2

0.70 FACTOR USED? YES
POPULATION < 10,000? No
N/A No

THRESHOLDS 1A/1B: 420/630 140/70 140/70

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 (	**MET SAME 1A/1B**
0:00 - 1:00			0	/		/		/	**/**
1:00 - 2:00			0	/		/		/	**/**
2:00 - 3:00			0	/		/		/	**/**
3:00 - 4:00			0	/		/		/	**/**
4:00 - 5:00			0	/		/		/	**/**
5:00 - 6:00			0	/		/		/	**/**
6:00 - 7:00	145	495	640	X/X	40	/	180	X/X	**X/X**
7:00 - 8:00	205	520	725	X/X	50	/	380	X/X	**X/X**
8:00 - 9:00	125	410	535	X/	35	/	245	X/X	**X/**
9:00 - 10:00	95	380	475	X/	25	/	200	X/X	**X/**
10:00 - 11:00	95	300	395	/	30	/	175	X/X	**/**
11:00 - 12:00	100	360	460	X/	40	/	230	X/X	**X/**
12:00 - 13:00	125	370	495	X/	35	/	305	X/X	**X/**
13:00 - 14:00	135	305	440	X/	45	/	305	X/X	**X/**
14:00 - 15:00	150	355	505	X/	50	/	380	X/X	**X/**
15:00 - 16:00	170	455	625	X/	60	/	390	X/X	**X/**
16:00 - 17:00	170	485	655	X/X	80	/X	455	X/X	**X/X**
17:00 - 18:00	140	360	500	X/	45	/	445	X/X	**X/**
18:00 - 19:00	105	320	425	X/	30	/	450	X/X	**X/**
19:00 - 20:00			0	/		/		/	**/**
20:00 - 21:00			0	/		/		/	**/**
21:00 - 22:00			0	/		/		/	**/**
22:00 - 23:00			0	/		/		/	**/**
23:00 - 24:00			0	/		/		/	**/**

	Met (Hr)	Required (Hr)	
Warrant 1A	**12**	8	**Satisfied**
Warrant 1B	3	8	Not satisfied
Warrant 2	**10**	4	**Satisfied**
Warrant 3	6	1	**Satisfied**
Warrant 7	**13**	8	**Satisfied, check accident record**

LOCATION: Ramsey at N Frontage Rd-TH 10 WB
COUNTY: Anoka
REF. POINT:
DATE: 1/29/2019
OPERATOR: KR

Speed	Approach Description	Lanes
45	Major App1: NORTHBOUND	2
45	Major App3: SOUTHBOUND	2
45	Minor App2: WESTBOUND	2
45	Minor App4: EASTBOUND	2

0.70 FACTOR USED? YES
POPULATION < 10,000? No
EXISTING SIGNAL ? No

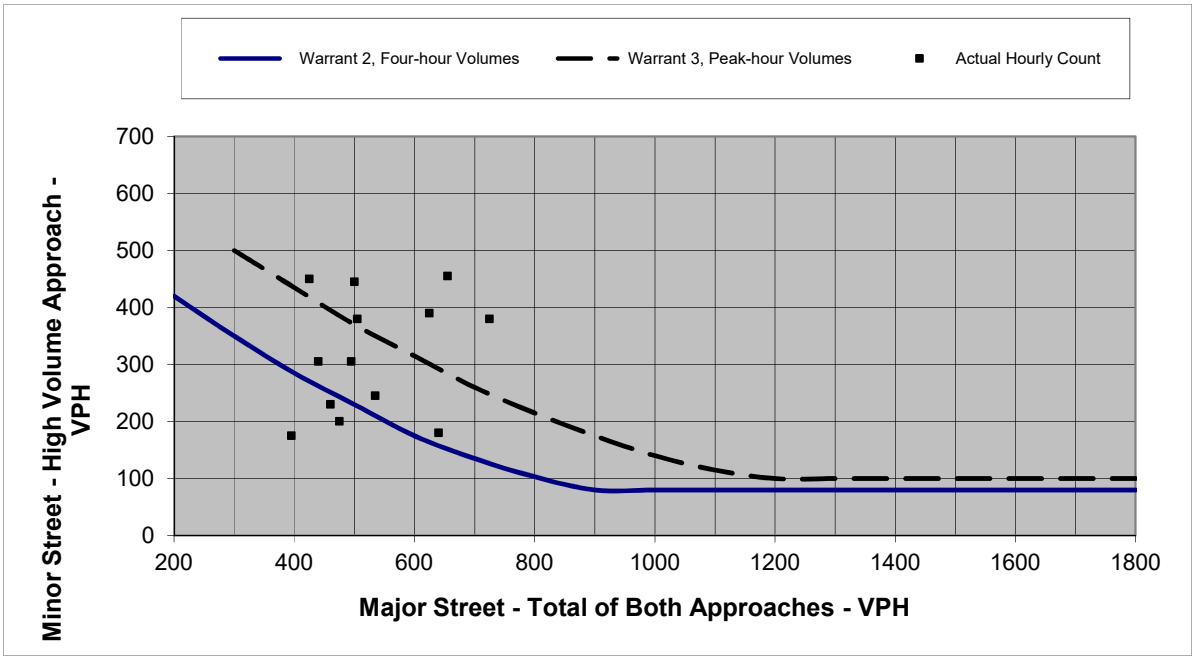


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, F	Warrant 3, Pe	Major	Actual Hourly Count
200	420		0	0
300	350	500	0	0
400	285	435	0	0
500	230	370	0	0
600	175	315	0	0
700	135	260	0	0
800	103	215	640	180
900	80	175	725	380
1000	80	140	535	245
1100	80	115	475	200
1200	80	100	395	175
1300	80	100	460	230
1400	80	100	495	305
1500	80	100	440	305
1600	80	100	505	380
1700	80	100	625	390
1800	80	100	655	455
			500	445
			425	450
			0	0
			0	0
			0	0
			0	0
			0	0

Table A7. 2025 RCUT Traffic Analysis

Option	Peak Hour	Aprch	Demand Volumes				Modeled Volumes				Model - Demand					Total Delay by Movement (sec/veh)			Level of Service by Movement			LOS by Approach		LOS		Traffic Queuing (feet)								
																										Left Turn			Through Queue			Right Turn		
			L	T	R	Total	L	T	R	Total	L	T	R	Total	%	L	T	R	L	T	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
Unsignalized RCUT	AM	EB	69	1980	13	2062	64	1984	16	2064	-5	4	3	2	0%	21	1	1	C	A	A	1	A	5	A	350	25	100		25	50	350	25	50
		WB	4	1305	16	1325	5	1212	12	1229	1	-93	-4	-96	-7%	33	1	1	D	A	A	1	A			350	25	50		0	0	350	25	100
		NB	18	4	1	23	19	5	2	26	1	1	1	3	13%	373	510	311	F	F	F	395	F				75	175		75	175		75	175
		SB	50	3	9	62	45	4	10	59	-5	1	1	-3	-5%	40	45	54	E	E	F	43	E				25	150		25	150		25	150
	PM	EB	161	1565	11	1737	128	1548	11	1687	-33	-17	0	-50	-3%	413	34	59	F	D	F	63	F	41	E	350	525	2100		300	1400	350	150	1400
		WB	3	2159	40	2202	3	2049	38	2090	0	-110	-2	-112	-5%	54	3	2	F	A	A	6	A			350	200	1025		25	100	350	200	1025
		NB	17	1	7	25	17	0	9	26	0	-1	2	1	4%	200	78	131	F	F	F	176	F				50	125		50	125		50	125
		SB	60	5	25	90	37	6	19	62	-23	1	-6	-28	-31%	740	963	390	F	F	F	654	F				250	525		250	525		250	525
Signalized RCUT	AM	EB	69	1980	13	2062	64	1984	16	2064	-5	4	3	2	0%	108	4	4	F	A	A	7	A	9	A	350	25	250		25	200	350	25	200
		WB	4	1305	16	1325	5	1207	12	1224	1	-98	-4	-101	-8%	91	3	3	F	A	A	5	A			350	25	225		25	225	350	25	225
		NB	18	4	1	23	17	4	2	23	-1	0	1	0	0%	172	167	48	F	F	D	160	F				25	75		25	75		25	75
		SB	50	3	9	62	46	4	10	60	-4	1	1	-2	-3%	133	123	39	F	F	D	117	F				25	100		25	100		25	100
	PM	EB	161	1565	11	1737	157	1572	10	1739	-4	7	-1	2	0%	102	3	4	F	A	A	12	B	14	B	350	75	475		25	150	350	25	150
		WB	3	2159	40	2202	3	2083	38	2124	0	-76	-2	-78	-4%	100	8	5	F	A	A	9	A			350	25	675		50	675	350	25	675
		NB	17	1	7	25	18	0	8	26	1	-1	1	1	4%	158	97	38	F	F	D	121	F				25	75		25	75		25	75
		SB	60	5	25	90	56	6	23	85	-4	1	-2	-5	-6%	164	188	63	F	F	E	138	F				25	175		25	175		25	175

Table A8. 2045 RCUT Traffic Analysis

Option	Peak Hour	Aprch	Demand Volumes				Modeled Volumes				Model - Demand					Total Delay by Movement (sec/veh)			Level of Service by Movement			LOS by Approach		LOS		Traffic Queuing (feet)								
																										Left Turn			Through Queue			Right Turn		
			L	T	R	Total	L	T	R	Total	L	T	R	Total	%	L	T	R	L	T	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
Signalized RCUT	AM	EB	230	1750	97	2077	214	1744	98	2056	-16	-6	1	-21	-1%	107	14	9	F	B	A	24	C	42	D	350	175	1100		175	1075	350	100	1075
		WB	49	2578	60	2687	44	2456	55	2555	-5	-122	-5	-132	-5%	104	24	21	F	C	C	27	D			350	175	1450		325	1450	350	175	1450
		NB	142	18	115	275	132	21	119	272	-10	3	4	-3	-1%	341	308	171	F	F	F	264	F				350	850		350	850		350	850
		SB	106	15	30	151	94	14	28	136	-12	-1	-2	-15	-10%	207	199	87	F	F	F	181	F				75	425		75	425		75	425
	PM	EB	96	2375	71	2542	88	2362	69	2519	-8	-13	-2	-23	-1%	111	18	13	F	B	B	21	C	34	C	350	225	1550		375	1550	350	200	1550
		WB	115	1425	18	1558	41	1444	16	1501	-74	19	-2	-57	-4%	108	8	8	F	A	A	13	B			350	25	225		25	225	350	25	225
		NB	154	45	55	254	146	46	55	247	-8	1	0	-7	-3%	280	278	143	F	F	F	249	F				250	825		250	825		250	825
		SB	90	10	13	113	83	11	12	106	-7	1	-1	-7	-6%	157	142	49	F	F	D	143	F				25	200		25	200		25	200
Dual Lane Signalized RCUT	AM	EB	96	2375	71	2542	88	2378	69	2535	-8	3	-2	-7	0%	108	9	7	F	A	A	12	B	25	C	350	50	725		50	725	350	50	725
		WB	115	1425	18	1558	43	1481	17	1541	-72	56	-1	-17	-1%	112	6	6	F	A	A	11	B			350	25	300		25	300	350	25	300
		NB	154	45	55	254	148	46	55	249	-6	1	0	-5	-2%	220	213	85	F	F	F	189	F				75	300		75	300		75	300
		SB	90	10	13	113	83	11	12	106	-7	1	-1	-7	-6%	144	138	39	F	F	D	132	F				25	125		25	125		25	125
	PM	EB	230	1750	97	2077	215	1745	100	2060	-15	-5	3	-17	-1%	104	8	6	F	A	A	18	C	30	C	350	100	700		50	650	350	25	650
		WB	49	2578	60	2687	44	2423	55	2522	-5	-155	-5	-165	-6%	106	17	16	F	B	B	20	C			350	150	1300		275	1300	350	150	1300
		NB	142	18	115	275	134	21	119	274	-8	3	4	-1	0%	221	222	69	F	F	E	155	F				75	300		75	300		75	300
		SB	106	15	30	151	99	14	28	141	-7	-1	-2	-10	-7%	168	148	72	F	F	E	147	F				50	200		50	200		50	200

Table A9. 2025 - Partial RCUT

Location	Peak Hour	Aprch	Demand volumes					Modeled Volumes					Model - Demand						Total Delay by Movement (sec/veh)				Level of Service by Movement				LOS by Approach		LOS		Traffic Queuing (feet)											
																															U-Turn			Left Turn			Through Queue			Right Turn		
			U	L	T	R	Total	U	L	T	R	Total	U	L	T	R	Total	%	U	L	T	R	U	L	T	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Storage	Avg	Max	Link Length	Avg	Max	Storage	Avg	Max
TH 10 at Bowers St *Stop Controlled*	AM	EB	2		2047	3	2050	1	1	2036	2	2039	-1	1	-11	-1	-11	-1%	7		2	2	A	-	A	A	2	A			600	25	50					0	0	500	25	50
		WB		17	1282		1299		9	1178		1187		-8	-104	0	-112	-9%		31	2		-	D	A	-	2	A	2	A				300	25	50		0	0			
		NB		6		12	18		5		13	18		-1	0	1	0	0%		11		1	-	B	-	A	4	A							25	25				25	25
	PM	EB	2		1672	6	1680	2		1643	5	1650	0		-29	-1	-30	-2%	9		2	2	A	-	A	A	2	A			600	25	25					0	0	500	25	25
		WB		12	2208		2220		11	2142		2153		-1	-66	0	-67	-3%		34	6		-	D	A	-	6	A	4	A				300	25	50		0	0			
		NB		3		17	20		2		18	20		-1	0	1	0	0%		11		1	-	B	-	A	2	A							25	25				25	25

Table A10. 2045 - Partial RCUT

Location	Peak Hour	Aprch	Demand volumes					Modeled Volumes					Model - Demand						Total Delay by Movement (sec/veh)				Level of Service by Movement				LOS by Approach		LOS		Traffic Queuing (feet)											
																															U-Turn			Left Turn			Through Queue			Right Turn		
			U	L	T	R	Total	U	L	T	R	Total	U	L	T	R	Total	%	U	L	T	R	U	L	T	R	Delay	LOS	Delay	LOS	Storage	Avg	Max	Storage	Avg	Max	Link	Avg	Max	Storage	Avg	Max
TH 10 at Bowers St *Stop Controlled*	AM	EB	2		2560	3	2563	2		2529	3	2532	0		-31	0	-31	-1%	9		4	3	A	-	A	A	4	A			600	25	50					25	150	500	25	150
		WB		17	1591		1608		9	1418		1427		-8	-173	0	-181	-11%		65	3		-	F	A	-	3	A	4	A				300	25	50		0	0			
		NB		6		20	26		8		18	26		2	0	-2	0	0%		23		1	-	C	-	A	8	A							25	50				25	50
	PM	EB	2		2054	6	2062	1		1980	5	1986	-1		-74	-1	-76	-4%	32		3	5	D	A	A	A	3	A			600	25	50					25	25	500	25	50
		WB		12	2711		2723		9	2601		2610		-3	-110	0	-113	-4%		44	2			E	A	A	2	A	2	A				300	25	75		0	0			
		NB		3		17	20		2		18	20		-1	0	1	0	0%		16		1		C	A	A	3	A							25	25				25	25

MEMORANDUM

To: Angie Bersaw, AICP

Cc: Eric Johnson, PE
Ross Tillman, PE
Kelsey Retherford, EIT
Bolton & Menk, Inc

From: Haifeng Xiao, PE, PTOE
HFTE, Inc

Date: March 7, 2019

Subject: Highway 10 Corridor Improvements Study
Daily Traffic Forecasts

Note: The traffic forecast memorandum dated January 3rd, 2019 has been approved by MnDOT in early this year. Since then, a new build alternative that assumes an overpass at the Sunfish Lake Boulevard/TH 10 intersection has been proposed and thus requires traffic forecast analysis. For ease of readability, this memorandum expands the previously approved memorandum to include the assumptions and traffic forecast results for this new alternative. The relevant content in italic font style is added to proper locations in the memorandum.

OVERVIEW

The Highway 10 Corridor Improvements project is located in the City of Ramsey, Minnesota. The purpose of this memorandum is to summarize the methodology, assumptions and daily traffic forecast results for the major roadways in the study area. The daily traffic forecasts were developed largely based on the latest Metro Council Activity Based Model (ABM).

TRAFFIC FORECAST LIMITS AND SCENARIOS

Figure 1 illustrates the study corridor and intersections. The daily traffic forecast limits include:

- Highway 10 within the City limits from East of Sunfish Lake Boulevard to West of Jarvis Street
- Major north-south roadways between Highway 10 and Bunker Lake Boulevard:
    - Sunfish Lake Boulevard
    - Ramsey Boulevard
    - Armstrong Boulevard
- Major east-west roadways between Sunfish Lake Boulevard and Armstrong Boulevard:
    - Bunker Lake Boulevard, north of Highway 10
    - Sunwood Drive, north of Highway 10
    - Riverdale Drive, south of Highway 10

To align with the anticipated project completion year, traffic forecasts were prepared for Design Year 2045 and Opening Year 2025 under No Build and Build Conditions. The 2045 No Build and Build Conditions assumed for developing the traffic forecasts are summarized below.

2045 No Build Scenario

- The regional transportation improvements assumed in the Thrive MSP 2040 by Metro Council (the latest Activity Based Model network)
- Committed Improvement Projects (CIPs) in the latest 2040 Anoka County Transportation Plan
- The TH 10 improvements recommended in the recently completed study, including a new TH 10 full access interchange at Thurston Avenue and a reconfigured TH 10 full access Interchange at Main Street in the City of Anoka

2045 Build Scenario

- No Build conditions as above
- TH 10 freeway between Armstrong Boulevard and Thurston Avenue with full access interchanges at Ramsey Boulevard and Sunfish Lake Boulevard (two lanes in each direction as existing)
- North Frontage Road between Ramsey Boulevard and Thurston Avenue with closure of the existing accesses on TH 10
- South Frontage Road between Armstrong Boulevard and Sunfish Lake Boulevard with closure of the existing accesses on TH 10

2045 Build V2 Scenario

- *2045 Build Scenario as above*
- *TH 10 freeway between Armstrong Boulevard and Thurston Avenue with a full access interchange at Ramsey Boulevard and an overpass with no access at the Sunfish Lake Boulevard intersection (two lanes in each direction as existing)*

The proposed improvements are illustrated in **Figure 3.1**. It is noted that the TH 10 improvements are still under study and haven't been finalized. The traffic forecasts developed for the above Build conditions should be re-evaluated and/or rerouted to reflect different build and interchange configurations.

TRAFFIC FORECAST METHODOLOGY AND STEPS

Due to the fact that the ABM model is only available for the base year and 2040, while the project design year is 2045 and opening year is 2025, the forecasts for this study were developed assuming linear growth from existing to 2040 and beyond. The traffic forecasts were prepared following the steps below:

1) The ABM used for the Anoka Country Transportation Updates was used for this study. During the County Transportation Plan Updates, the ABM was refined in the Anoka County area to include the latest Capital Improvement Projects by 2040 in the region and a number of coding errors were fixed (the errors and issues have been regularly reported to Metro Council).

2) The previously refined ABM was reviewed and further refined in the study area to include more detailed street network and socio-economic (SE) data inputs.

3) The 2040 No Build and Build models were developed by modifying the refined ABM based on the assumptions described in the previous section.

4) The models were rerun and the 2040 No Build and Build model results were adjusted accordingly to develop 2040 daily traffic forecasts for major roadways under No build and Build conditions, based on the differences between the 2015 base model results and actual Average Daily Traffic (ADTs), to account for the modeling errors.

5) Both of the No Build and Build daily traffic forecasts for 2025 and 2045 were estimated based on the 2040 forecasts and existing ADTs assuming linear growth from existing to 2040 and beyond. The exceptions were for the roadways located between Highway 10 and Mississippi River. No further growth was assumed after the full development by 2040 due to a lack of regional through trips using the roadways.

6) The traffic forecasts were reviewed for reasonableness. It is noted that the daily traffic forecasts and growth will be used to develop peak hour traffic forecasts for the key study intersections in the subsequent operations analysis. In this process, engineering judgements and manual adjustments might be needed based on more detailed and disaggregated local counts to account for peak spreading under over-congested conditions and different growth from different approaches.

STUDY AREA NETWORK AND SE DATA REVIEW

The roadway network and socio-economic data are two major inputs for any travel demand model. The existing and 2040 network and SE data in the study area were reviewed to ensure their accuracy and consistency with the City's latest plan. The 2040 highway network was modified to include the Highway 10 Improvements between Thurston Avenue and Main Street in the City of Anoka.

Figure 1 in the appendix illustrates the Metro Council TAZs in the study area**. Table 1** below summarizes the SE data in the ABM. The data are consistent with the City's latest plan and the Thrive MSP 2040 adopted by the Metro Council. It can be seen that the socio-economic development in the study area has much higher growth rates than the City and other regions, especially the household and population. It is noted that the City is currently engaged in ongoing discussion with the Metro Council to increase the 2040 SE forecasts for the City, but no conclusion has been reached. The traffic forecasts would need to be re-evaluated, if there are any changes to the land uses plan in the future.

Table 1
Socioeconomic Data Summary in the ABM

Area	HH2015	HH2040	Annual Growth	POP2015	POP2040	Annual Growth	EMP2015	EMP2040	Annual Growth
TAZ 59	257	466	3.3%	694	1,215	3.0%	114	106	-0.3%
TAZ 60	83	473	18.8%	242	1,290	17.3%	60	239	11.9%
TAZ 61	4	86	82.0%	10	227	86.8%	22	56	6.2%
TAZ 62	154	589	11.3%	407	1,546	11.2%	130	659	16.3%
TAZ 63	262	967	10.8%	706	2,517	10.3%	581	782	1.4%
TAZ 64	80	82	0.1%	237	227	-0.2%	1,562	1,656	0.2%
TAZ 65	424	606	1.7%	1,151	1,606	1.6%	237	428	3.2%
TAZ 66	0	0	N/A	0	0	N/A	791	962	0.9%
Study Area (TAZ 59-66)	1,264	3,269	6.3%	3,447	8,628	6.0%	3,497	4,888	1.6%
Ramsey City	8,724	13,001	2.0%	25,044	34,700	1.5%	5,496	7,603	1.5%
Anoka County	130,382	173,672	1.3%	348,104	443,801	1.1%	121,382	151,138	1.0%
Metro 7-County	1,191,018	1,495,086	1.0%	2,997,135	3,656,400	0.9%	1,670,462	2,043,237	0.9%

TRAFFIC FORECASTS RESULTS

Based on the methodology, assumptions and steps described in the previous sections, daily traffic forecasts were prepared for the Design Year 2045 and Opening Year 2025 under No Build and Build conditions.

2045 No Build Traffic Forecasts

Figure 2.1 illustrates the existing ADTs and 2045 No Build daily traffic forecasts on the major roadways in the study area.

Figure 2.2 illustrates the existing ADTs and 2025 No Build daily traffic forecasts on the major roadways in the study area.

Figure 2.3 illustrates the daily traffic average annual growth rates from existing to 2045 on the major roadways in the study area under No Build conditions.

2045 Build Traffic Forecasts

Figure 3.1 illustrates the 2045 No Build and Build daily traffic forecasts on the major roadways in the study area for comparison purposes. There are two interesting phenomena:

- The Build and No Build daily traffic forecasts are respectively 79,000 and 74,200 on TH 10 East of Sunfish Lake Boulevard (difference of 6.4%). They are respectively 48,900 and 48,800 on TH 10 near Alpine Drive (~0% difference). The differences between the traffic forecasts on TH 10 are not substantial, especially west of Armstrong Boulevard, due to the capacity constraint on the west.
- The traffic forecasts are noticeably higher on Armstrong Boulevard and Ramsey Boulevard under Build conditions than No Build conditions, while they are lower on Sunfish Lake Boulevard. It indicates that vehicles would be likely to use the local roads to avoid the congestion on TH10 between Sunfish Lake Boulevard and Armstrong Boulevard under No Build conditions. The traffic patterns on the local roads change accordingly, resulting in lower or higher traffic volumes under Build conditions than No Build conditions.

Figure 3.2 illustrates the existing ADTs and 2045 Build daily traffic forecasts on the major roadways in the study area.

Figure 3.3 illustrates the existing ADTs and 2025 Build daily traffic forecasts on the major roadways in the study area.

Figure 3.4 illustrates the daily traffic average annual growth rates from existing to 2045 on the major roadways in the study area under Build conditions.

2045 Build V2 Traffic Forecasts

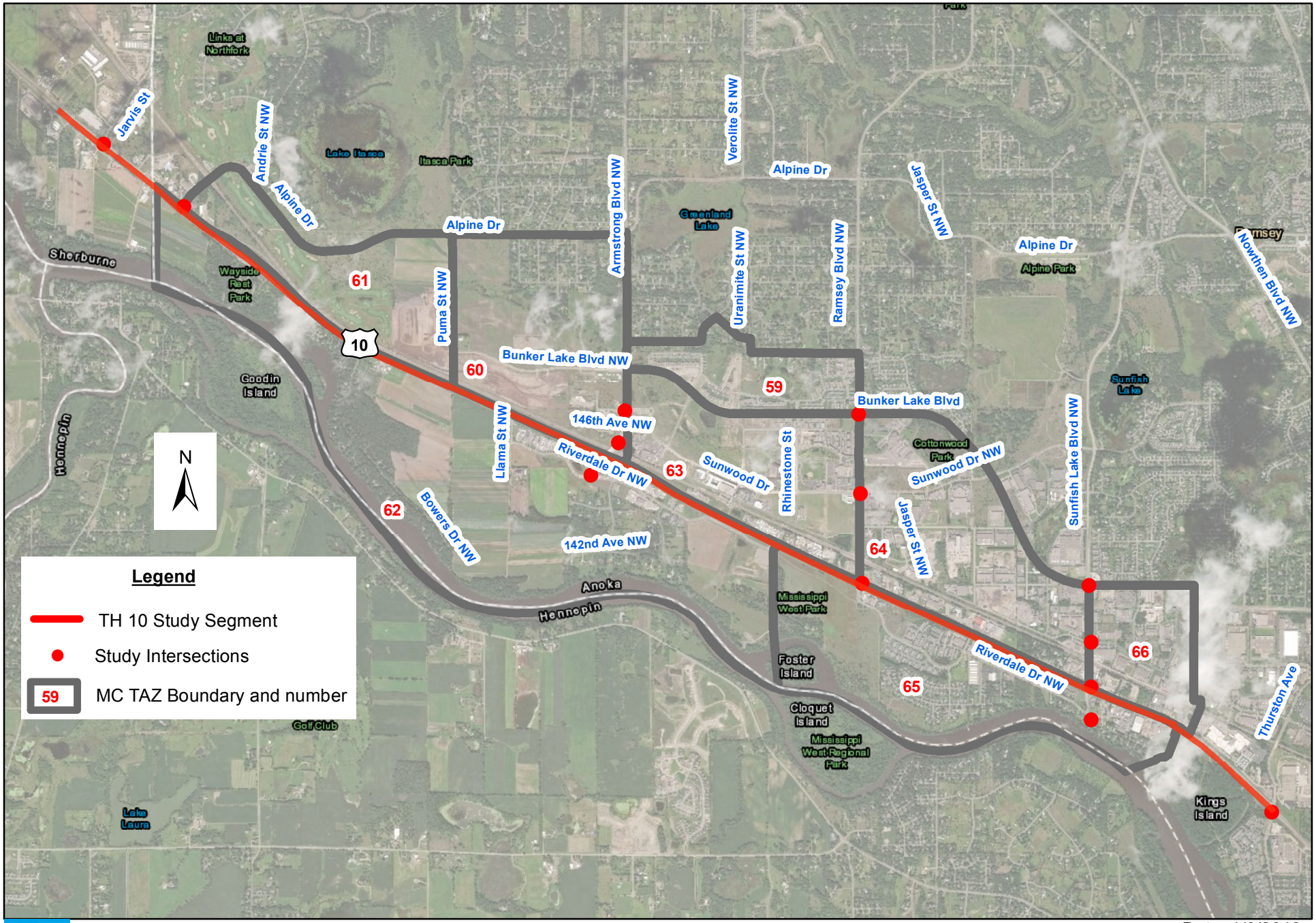
***Figure 4.1** illustrates the 2045 No Build and Build V2 daily traffic forecasts on the major roadways in the study area for comparison purposes. The figure shows that*

- *The traffic volumes on Sunfish Lake Boulevard north of TH 10 under Build V2 conditions will be lower than those under the No Build conditions. Compared with the Build conditions, the traffic volumes on Ramsey Boulevard will increase slightly with no noticeable changes on Armstrong Boulevard.*
- *The traffic volumes on the New Frontage Road in the northeast of Sunfish Lake Boulevard/TH 10 will increase substantially due to the access closure at TH 10.*

***Figure 4.2** illustrates the existing ADTs and 2045 Build V2 daily traffic forecasts on the major roadways in the study area.*

***Figure 4.3** illustrates the existing ADTs and 2025 Build V2 daily traffic forecasts on the major roadways in the study area.*

***Figure 4.4** illustrates the daily traffic average annual growth rates from existing to 2045 on the major roadways in the study area under Build V2 conditions.*

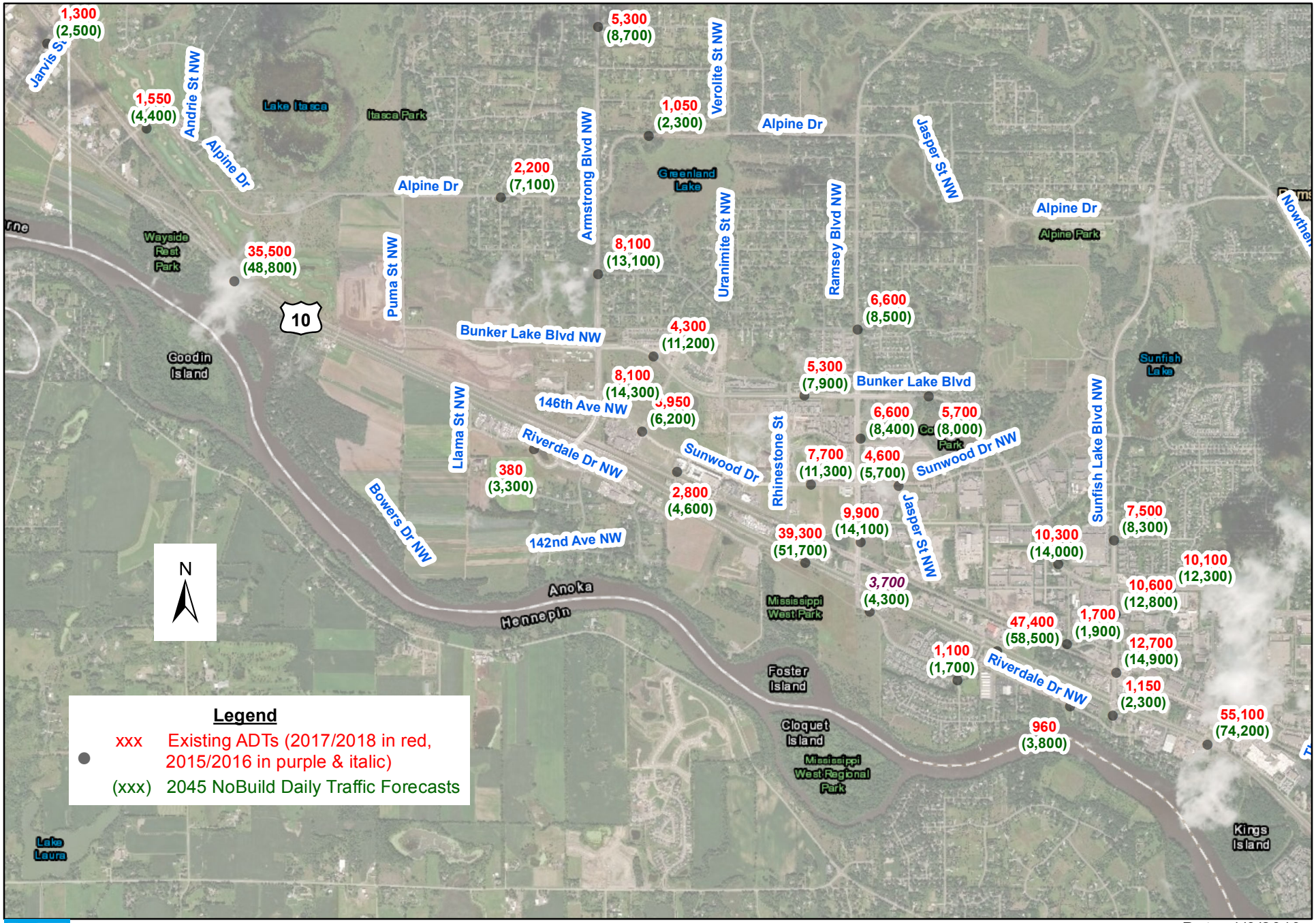


Date: 1/3/2019

TH 10 Study Segment, Intersections and TAZs

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 1

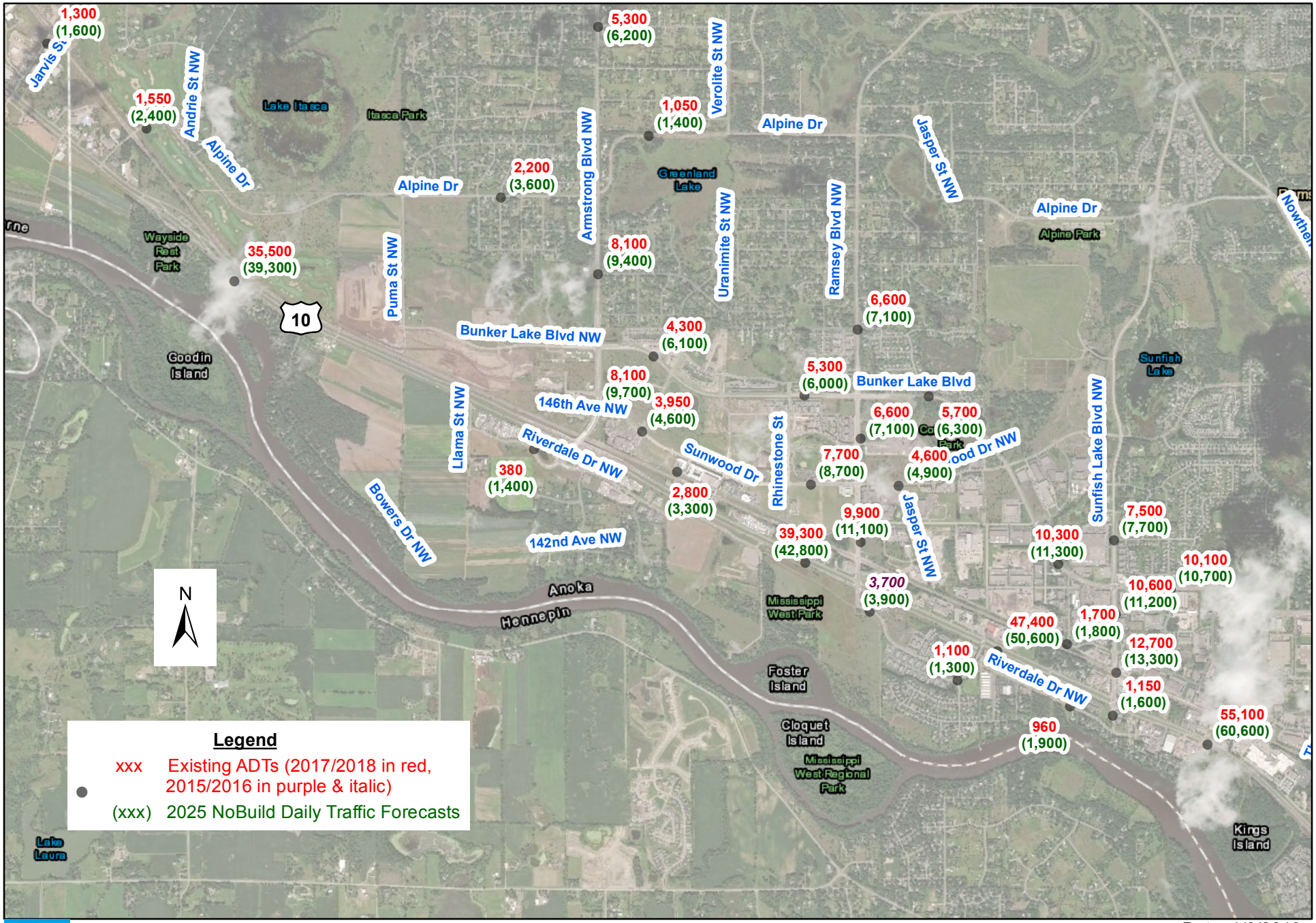


Date: 1/3/2019

Existing ADTs and Design Year 2045 No Build Daily Traffic Forecasts

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 2.1

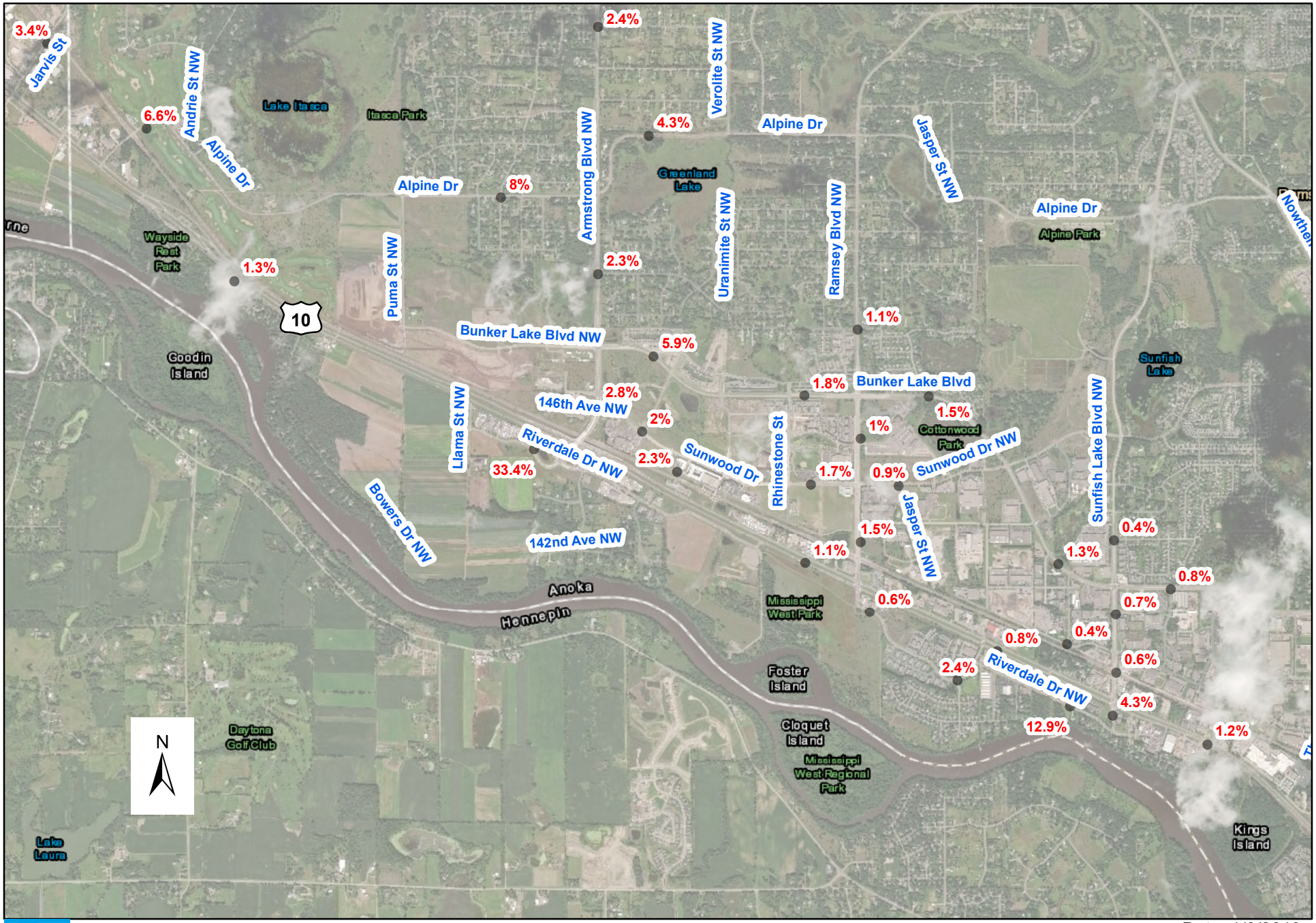


Date: 1/3/2019

Existing ADTs and Opening Year 2025 No Build Daily Traffic Forecasts

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 2.2

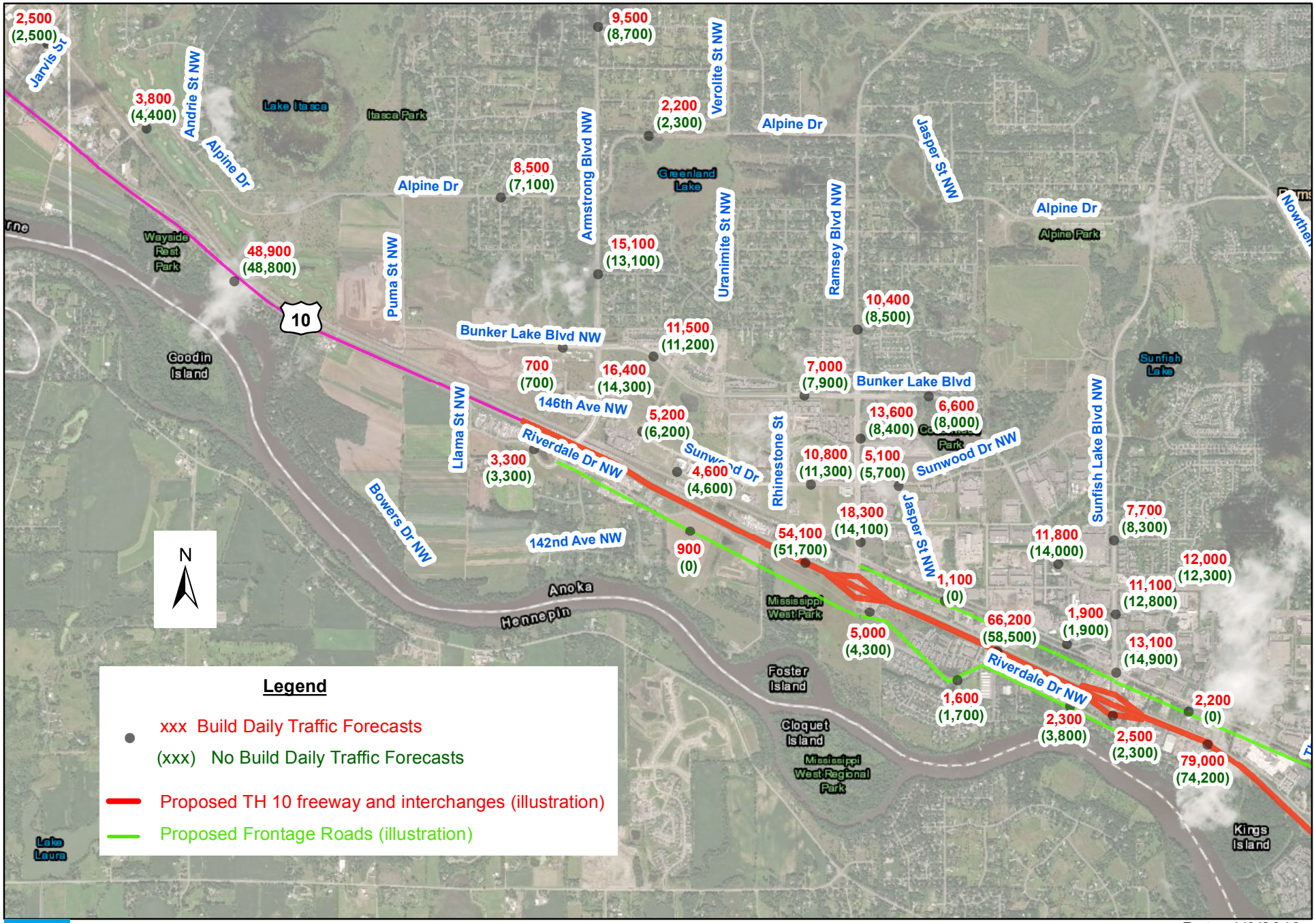


Daily Traffic Average Annual Growth Rates from Existing to 2045
(No Build Conditions)

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Date: 1/3/2019

Figure
2.3

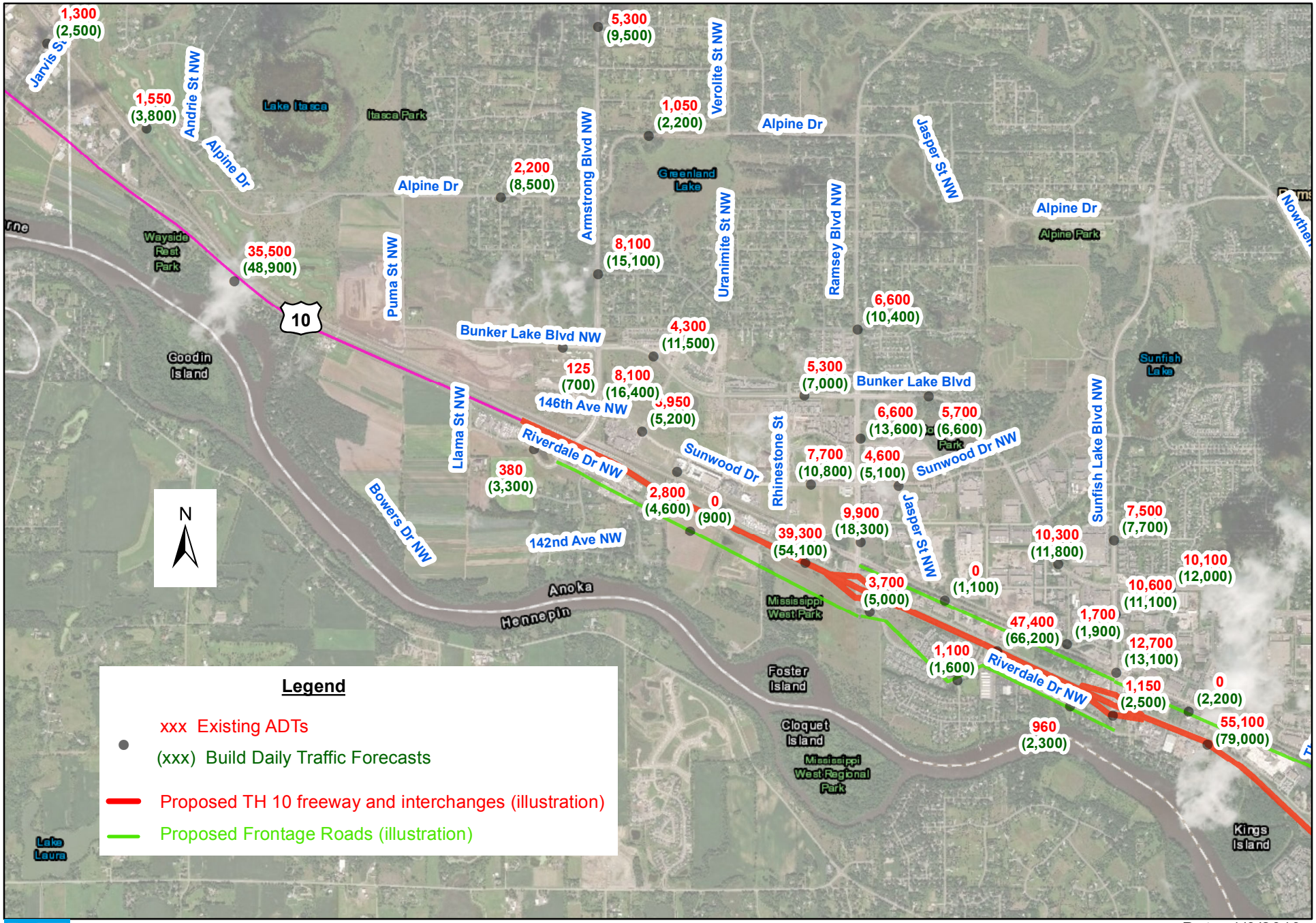


Date: 1/3/2019

Year 2045 Build and No Build Daily Traffic Forecasts

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 3.1

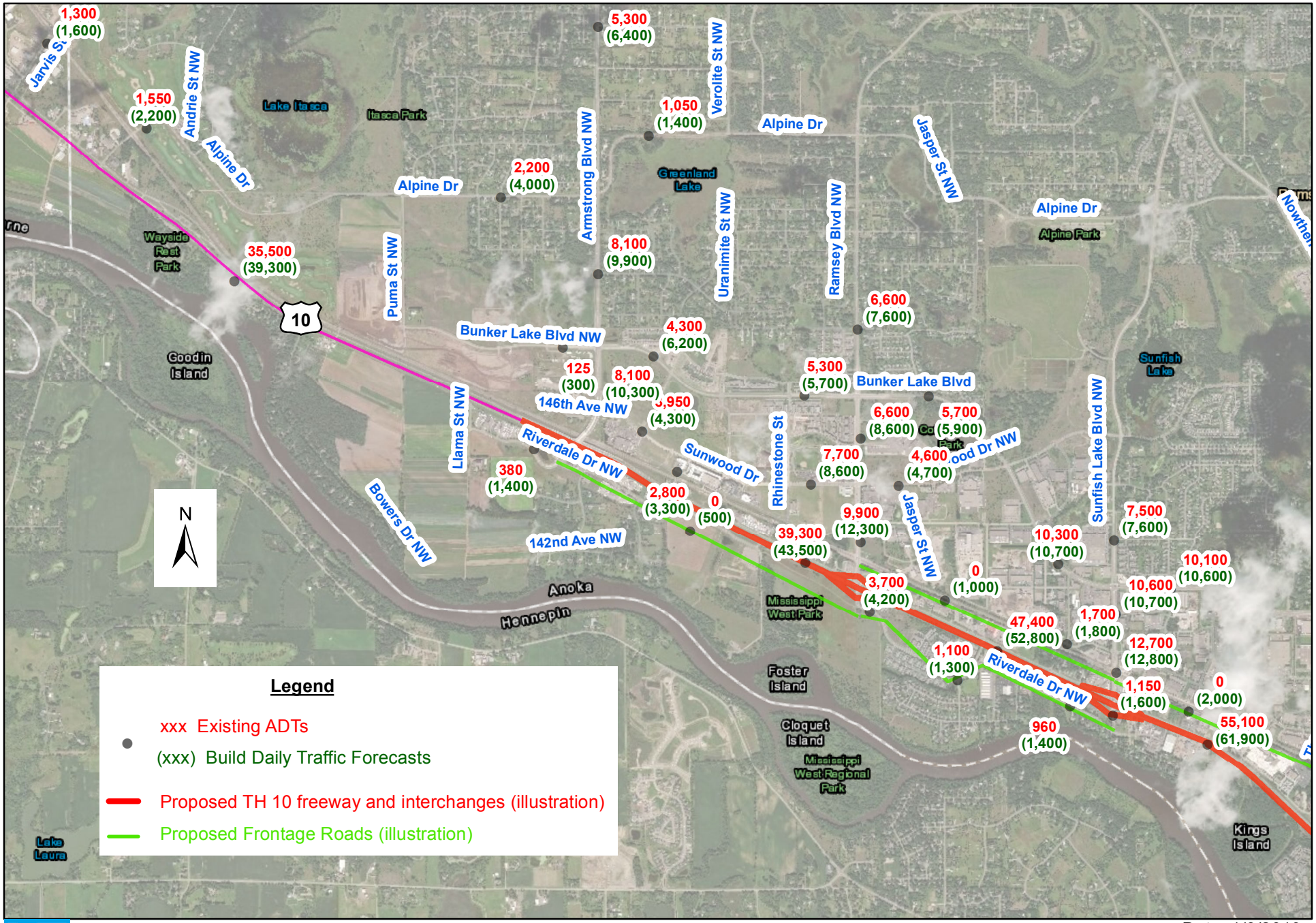


Date: 1/3/2019

Existing ADTs and Design Year 2045 Build Daily Traffic Forecasts

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 3.2

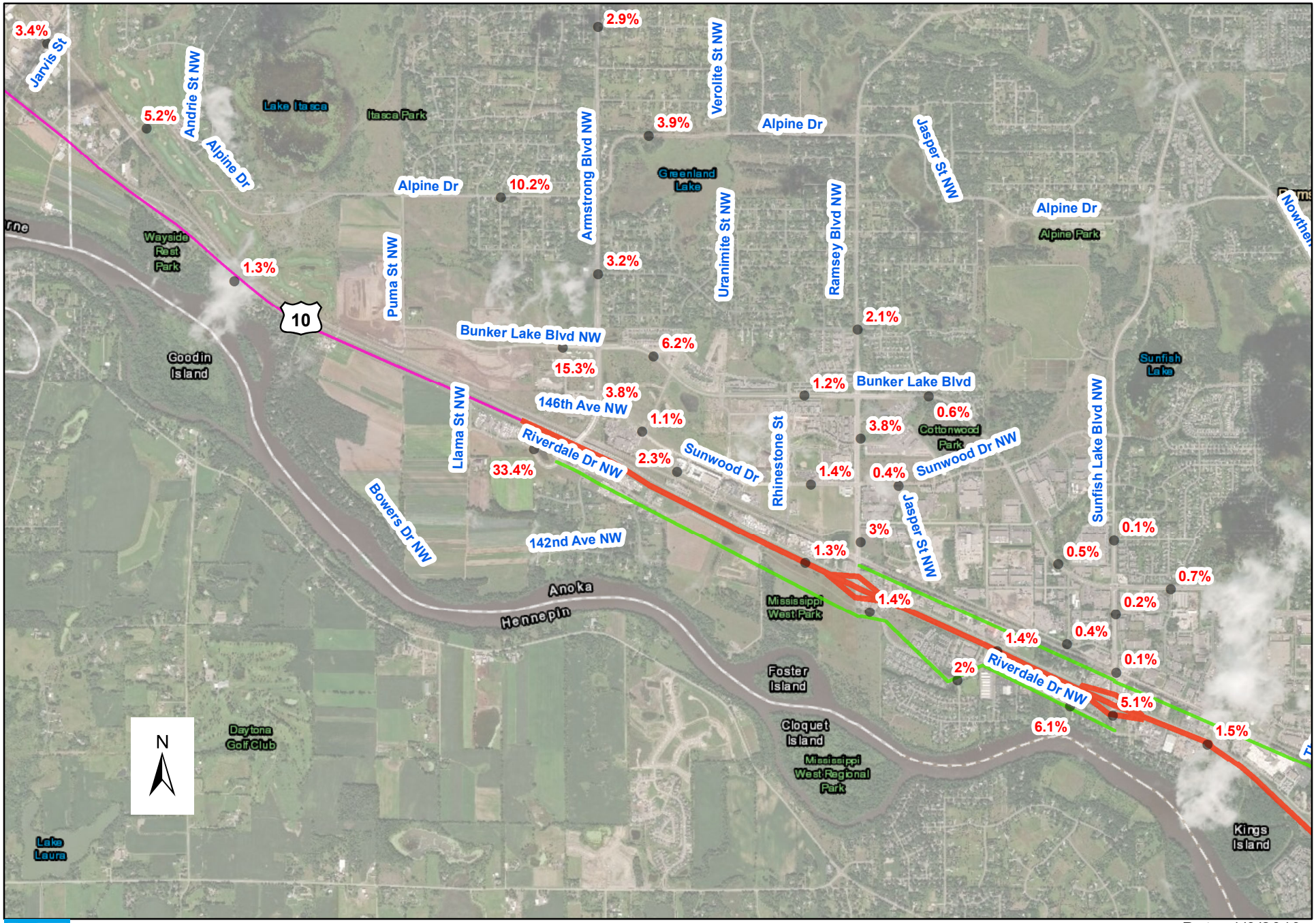


Date: 1/3/2019

Existing ADTs and Design Year 2025 Build Daily Traffic Forecasts

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 3.3

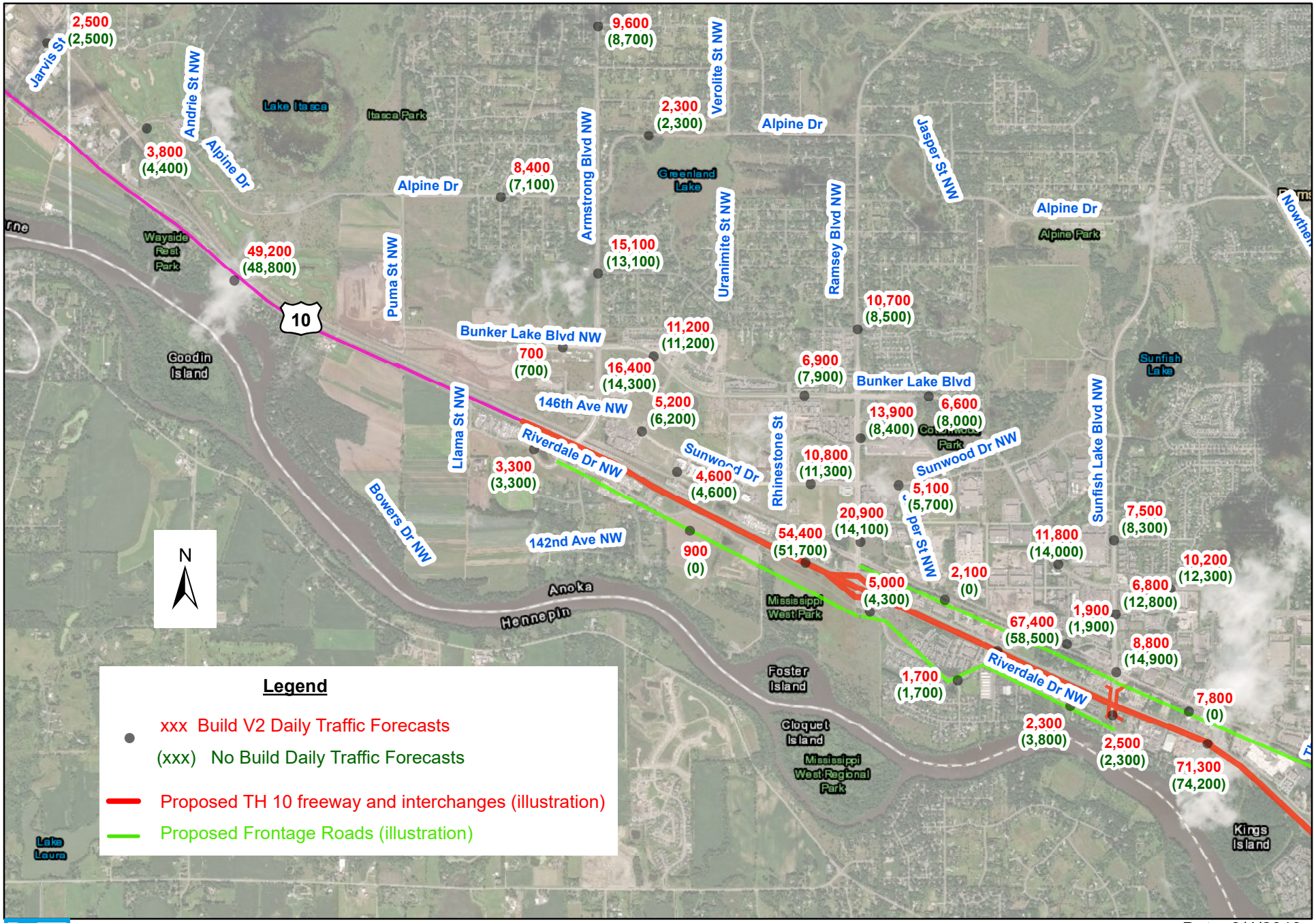


Daily Traffic Average Annual Growth Rates from Existing to 2045
(Build Conditions)

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Date: 1/3/2019

Figure
3.4

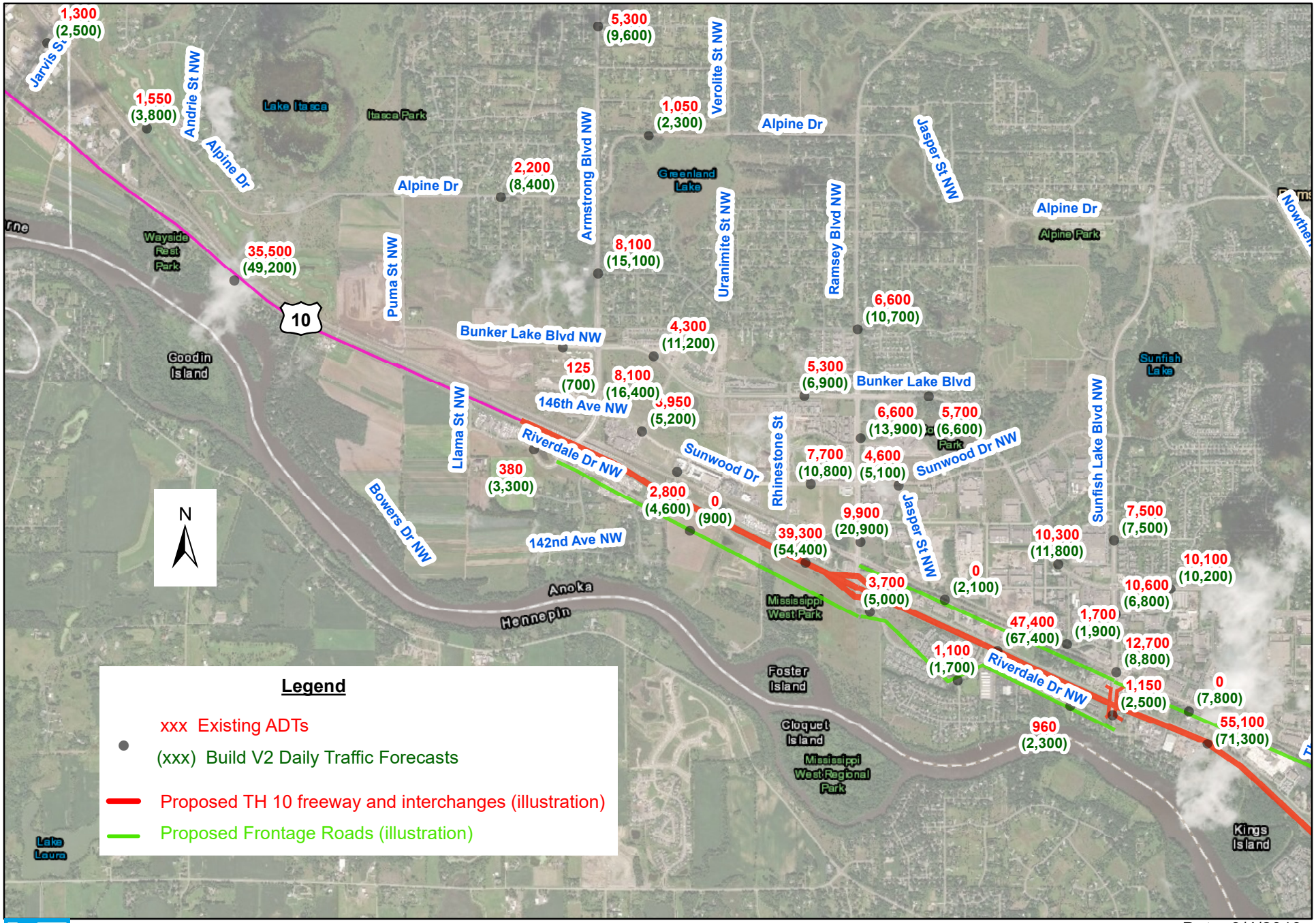


Date: 3/4/2019

Year 2045 Build V2 (Overpass at Sunfish Lake Blvd) and No Build Daily Traffic Forecasts

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 4.1

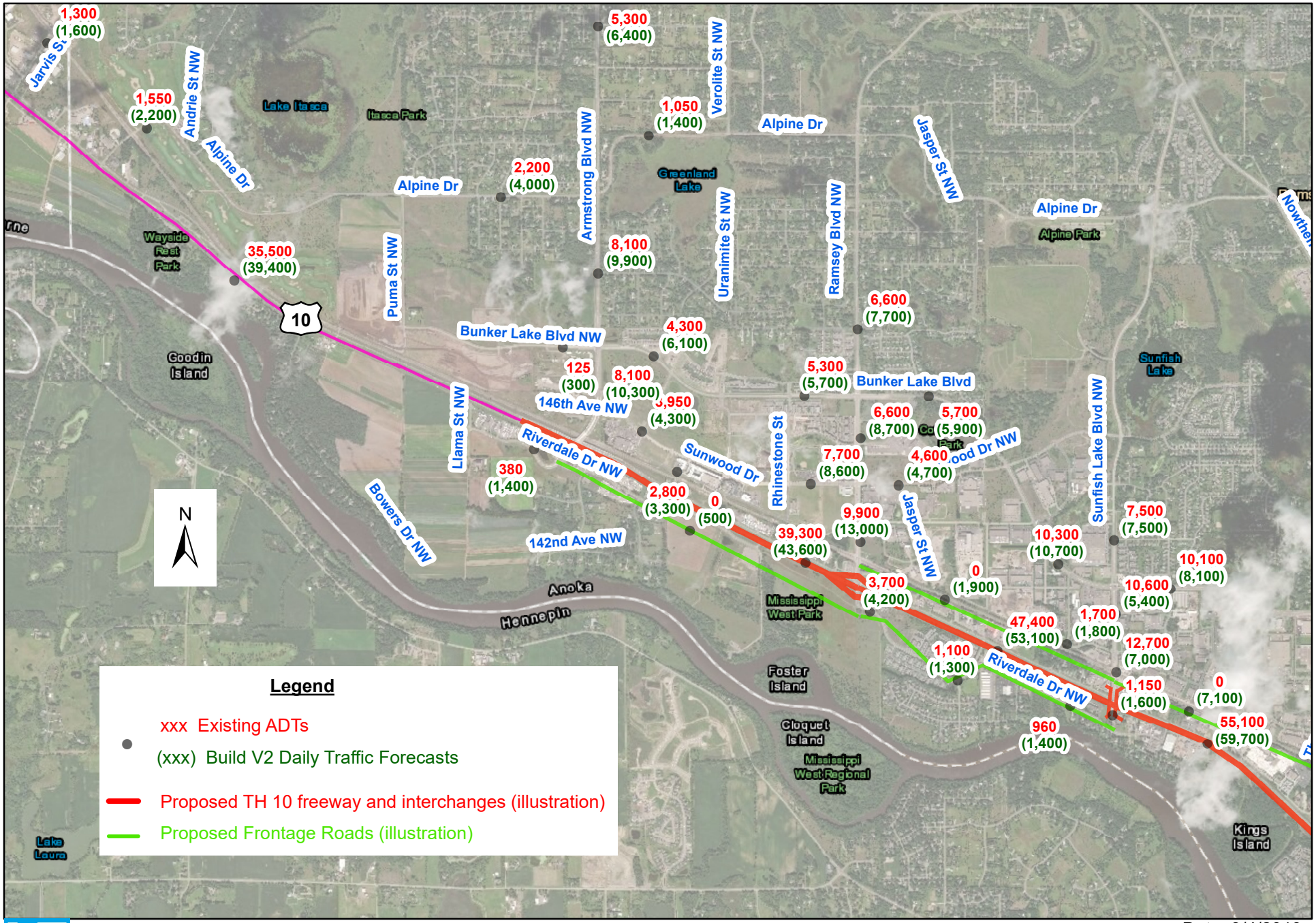


Date: 3/4/2019

Existing ADTs and Design Year 2045 Build V2 (Overpass at Sunfish Lake Blvd) Daily Traffic Forecasts

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 4.2

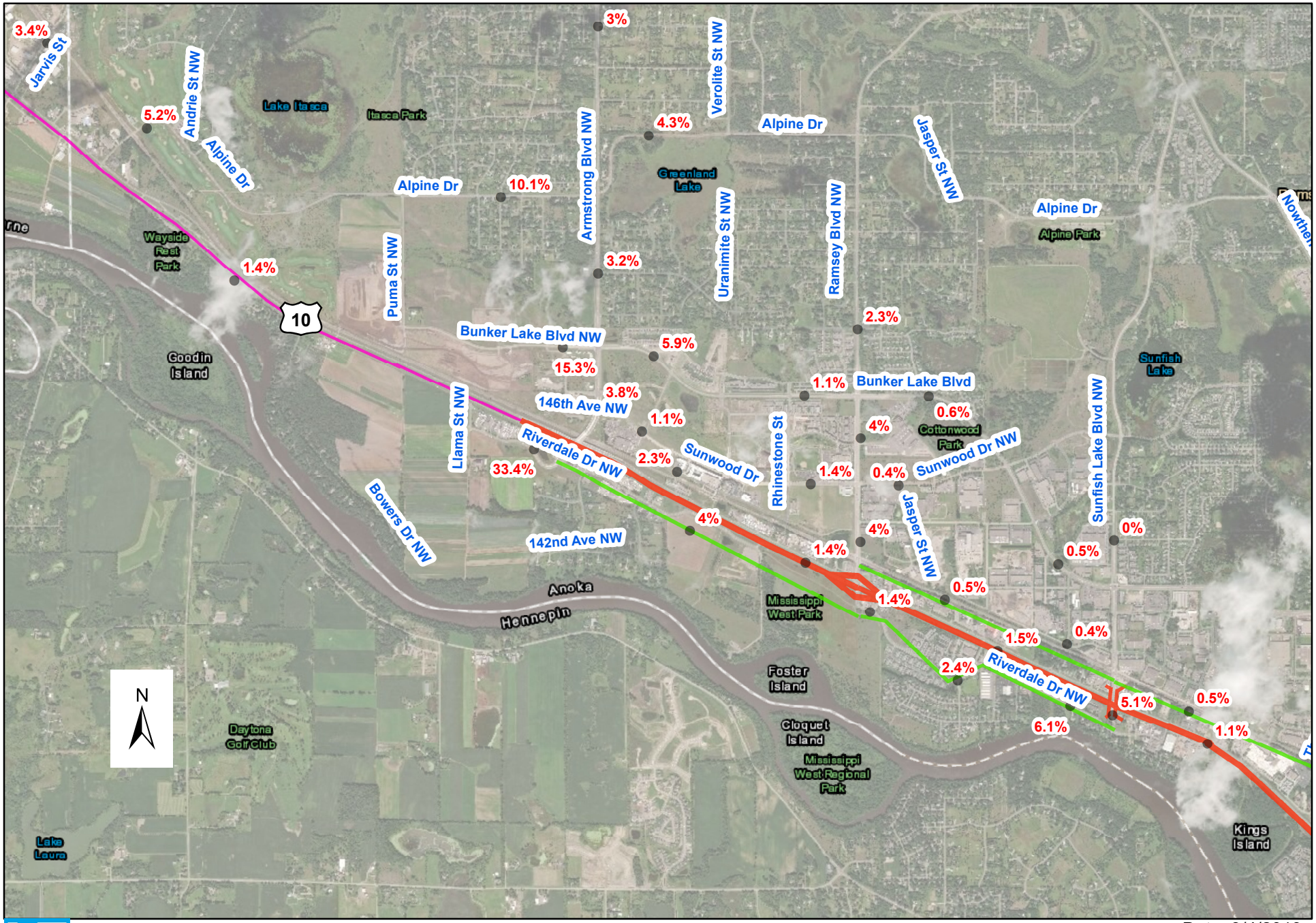


Date: 3/4/2019

Existing ADTs and Opening Year 2025 Build V2 (Overpass at Sunfish Lake Blvd) Daily Traffic Forecasts

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 4.3



Date: 3/4/2019

Daily Traffic Average Annual Growth Rates from Existing to 2045
(Build V2 Conditions: Overpass at Sunfish Lake Blvd)

TH 10 Corridor Improvements Study
City of Ramsey, Minnesota

Figure 4.4