

TRAFFIC IMPACT STUDY

St. Olaf Student Housing
Northfield, MN

June 24, 2020

Project No. 20-23959

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St. Olaf Student Housing
Northfield, Minnesota

Engineer's Project Number: 20-23959

Dated this 24th day of June, 2020

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EXECUTIVE SUMMARY

Studied Intersection Description and Location

This Traffic Impact Study (TIS) studied current, projected, and future traffic conditions at two locations in the City of Northfield, Rice County, Minnesota. These locations included:

- Intersection 1 – The intersection of Minnesota Trunk Highway 19 (Hwy 19 Blvd) and St. Olaf Drive
- Intersection 2 – The intersection of County State Aid Highway 43 (Lincoln Street North) and St. Olaf Avenue

Turning movement traffic count data was not collected at any intersection. At the time of writing, the COVID-19 virus pandemic has had unprecedented and ongoing impacts on travel behavior. As a result, ISG did not conduct a traffic count in preparation for this study. Traffic was analyzed based on recorded Minnesota Department of Transportation (MnDOT) and area land use information to assist with existing and proposed trip distribution.

The proposed project involves the removal of existing honor houses and the president's house and the construction of a residence hall and townhome residences designed to accommodate 440 students. The residence hall and townhome residences would be constructed along St. Olaf Avenue within St. Olaf College property west of Lincoln Street N and north of Hwy 19 Blvd. A new 182-stall parking lot will be included in the proposed project to supplement existing student parking. St. Olaf College has two main campus entrances, St. Olaf Avenue connecting to Lincoln Street N and St. Olaf Drive connecting to Hwy 19 Blvd. No other major main access points will be introduced as a part of the proposed project.

Adjacent properties west and north of St. Olaf college are used for and zoned as residential, properties to the south are commercial and industrial, and land to the west and north is undeveloped.

Hwy 19 Blvd and Lincoln Street N are two-lane, undivided, asphalt-surfaced, arterial highways with posted or regulatory speeds ranging from 30 MPH to 45 MPH. The T-intersection of Hwy 19 Blvd and St. Olaf Drive is stop-controlled on St. Olaf Drive. The intersection of Lincoln Street N and St. Olaf Avenue is all-way stop-controlled.

Hwy 19 Blvd provides wide-paved-shoulder type bicycle facilities and no pedestrian facilities, and Lincoln Street N provides pedestrian facilities and no bicycle facilities. Pedestrian and bicyclist activity is expected on Lincoln Street N due to its proximity to campus and the availability of on-street parking within the adjacent residential neighborhood. Pedestrian and bicyclist activity on Hwy 19 Blvd is expected to be minimal, despite the presence of wide-paved-shoulder type bicycle facilities, due to the limited amount of residential property nearby and distance from destination points in the City of Northfield. Local and regional bus routes use St. Olaf Avenue for access to and from campus. Many of the students who live off campus are within a half mile of campus in the adjacent residential neighborhood east of campus where the Northfield Blue route runs regularly. It is assumed that most of the students who live in this neighborhood walk, bike, or bus to campus rather than drive.

Analysis

Traffic volumes, design adjustment factors, and turning behaviors for the Existing (2022) condition were assumed and analyzed. Then, trips were reallocated within the study area to account for the redistribution of trips in the Proposed (2022) condition. The Existing (2022) and Opening (2022) conditions were analyzed within Sychro Version 10.3 using the Highway Capacity Manual, 6th Edition Delay Method for level of service and delay. SimTraffic was used for microsimulation and queuing analysis.

Findings

According to traffic modeling using Synchro and SimTraffic, the proposed St. Olaf Student Housing project will have minimal impacts to the intersection of Hwy 19 Blvd and St. Olaf Drive and the intersection of Lincoln Street N and St. Olaf Avenue. The existing intersection geometry and roadway link infrastructure are sufficient to handle existing and opening traffic volumes. Both studied intersections have appropriate intersection control.

Recommendations + Conclusions

The City of Northfield should consider installing and maintaining pedestrian and bicycle facilities in accordance with its current *City of Northfield Pedestrian, Bike, and Trail System* report and the *City of Northfield Americans with Disabilities Act Pedestrian Facilities Transition Plan*, once completed, regardless of the proposed development. This would include installing trails or sidewalks along Lincoln Street N and St. Olaf Avenue, maintaining ADA compliant curb ramps at the intersection of Lincoln Street N and St. Olaf Avenue, and constructing/installing a bicycle lane along Lincoln Street N. No improvements are recommended along Hwy 19 Blvd, Lincoln Street N, St. Olaf Drive, or St. Olaf Avenue in order to accommodate future redistribution of existing traffic. The area should be re-evaluated as growth projections change or when other development occurs in the future.

INTRODUCTION

Purpose of Report

The purpose of this report is to document the methodologies, findings, recommendations, and conclusions of the St. Olaf Student Housing development traffic impact analysis study, including the basis for all assumptions, traffic parameters, and conclusions. This report presents data in a logical format including tables and figures in order to accurately and clearly convey the data and its meaning.

Study Objectives

The objectives of this study include the following:

1. Identify the impacts to the transportation system and immediate area as a result of the proposed development.
2. Recommend necessary improvements to the adjacent transportation system to minimize safety risk and maintain an efficient system.
3. Provide sufficient access for all users and modes of traffic to the proposed development.

EXISTING CONDITIONS

Project Overview

This report studies the impacts of a proposed on-campus student housing facility for St. Olaf College in the City of Northfield, Minnesota. A preliminary site plan is provided in **Appendix A**, and a project location map is provided in **Appendix B**. More details regarding site traffic and trip generation are provided in a later section of this report. St. Olaf College is a private liberal arts college that has consistently enrolled about 3,000 students in the fall semester since 2015.

At the time of writing, the COVID-19 virus pandemic has had unprecedented and ongoing impacts on travel behavior. As a result, ISG did not conduct a traffic count in preparation for this study. Higher education school facilities, including St. Olaf College, suspended in-person instruction through much of April and May. St. Olaf College students only attended classes online starting April 6 and online instruction will continue through the summer term. A Stay at Home order was issued by Minnesota State government directing Minnesotans to limit movements outside of their homes to essential needs and was effective until May 18th. Since, a Stay Safe Minnesota Plan has been put in place limiting the in-person school learning and promoting distance learning until further notice. It's likely that effects of the COVID-19 pandemic will continue until social distancing measures recommended by state and federal governments are lifted. It is unknown when local travel patterns will return to what was considered normal pre-COVID-19. Intersection traffic counts conducted at this time would result in data unrepresentative of the roadways' typical traffic conditions.

At St. Olaf College, all full-time students are required to live on campus or in campus-owned housing as accommodations permit. There has been a housing shortage at St. Olaf College since the mid-1990's and the St. Olaf College reports an annual deficit of 462 beds. The proposed residence hall and townhome style residences are designed to accommodate a total of 440 students, increasing student housing capacity at St. Olaf College. To facilitate the residential hall and townhome construction, existing honor houses on the north side of St. Olaf Avenue and the president's residence would be razed. The new townhomes would allow St. Olaf College and students to redevelop the current honor house program. Construction was previously planned for Fall 2020; however, the project has been put on hold due to the ongoing impacts of the COVID-19 pandemic on safe gathering and in-person instruction. Engineering and design work continues to ensure that construction can begin as soon as it is safe for students to return to campus. St. Olaf College hopes the proposed project will be ready for use by 2022.

The project will also provide 182 additional student parking stalls on the north side of the project area. The parking lot construction will expand on the St. Olaf College's existing parking infrastructure and will increase parking capacity, allowing for more students to park on campus. A comprehensive parking study has been developed in conjunction with the St. Olaf Student Housing Traffic Impact Study and can be obtained by contacting either St. Olaf College or the City of Northfield.

The intersections formed by Hwy 19 Blvd, Lincoln Street North, and St. Olaf College's two primary access points were studied. The figure in **Appendix C** identifies these intersections and illustrates their location within the Northfield area.

Land use surrounding St. Olaf College includes low density residential to the east and north, commercial and industrial to the south, and undeveloped land to the west and north. About two-thirds of the undeveloped land is planned considered environmentally significant and/or is planned for preservation and the last third is planned for managed growth consistent with the character of the existing land. Zoning in these areas is consistent with existing land use. The undeveloped areas to the north and west are outside of the City of Northfield's city limits and are zoned by Rice County as Urban Reserve. The City of Northfield's existing zoning map is provided as **Appendix D**.

Area Roadway System

Through and adjacent to the study area:

- Hwy 19 Blvd is an east-west principal arterial
- Lincoln Street N is a north-south minor arterial
- St. Olaf Avenue and St. Olaf Drive are local or campus streets

Hwy 19 Blvd is a two-lane, undivided, asphalt-surfaced State highway that connects the City of Northfield Interstate Highway 35 (I-35) to the west. Public roadway and private driveway accesses are frequent along Hwy 19 Blvd, and turn lanes are generally not provided. A right-turn lane and left-turn bypass lane are located on Hwy 19 Blvd for St. Olaf Drive. Hwy 19 Blvd and St. Olaf Drive form a T-intersection with the stop sign on St. Olaf drive. Hwy 19 Blvd is also known as Minnesota Trunk Highway 19 or TH 19. Hwy 19 Blvd connects to Lincoln Street S via Armstrong Road, also known as Forest Avenue. Lincoln Street S turns into Lincoln Street N after 1st St W to the north. Lincoln Street N is a two-lane, undivided, asphalt-surfaced County highway that runs within the City of Northfield. In the future, Lincoln Street N/S may be transferred from Rice County ownership to the City of Northfield. St. Olaf Avenue's intersection with Lincoln Street N is all-way stop-controlled. No turn lanes are provided at this intersection.

Hwy 19 Blvd has a posted speed of 45 MPH at its intersection with St. Olaf Drive. East on Hwy 19 Blvd, closer to the City of Northfield, the posted speed is 35 MPH. Lincoln Street N and St. Olaf Avenue have posted or regulatory speeds of 30 MPH. St. Olaf Drive has a posted speed of 15 MPH.

According to data accessed using MnDOT's Traffic Mapping Application, heavy vehicles make up about 8% of total traffic. Heavy vehicle traffic data is not available for Lincoln Street N; however, due to the lower volume and residential nature of Lincoln Street N, it is assumed that trucks make up about 2% of traffic.

Hwy 19 Blvd has 12-foot paved shoulders. 8'-10' paved shoulders are considered a sufficient bicycle treatment for urban roadways with 2 travel lanes and average daily traffic of more than 10,000 vehicles per day (*Department of Transportation State Aid for Local Transportation Division* Section 8820.9941). Lincoln Street N's shoulders are about 4.5 feet wide. 5'-6' bicycle lanes are considered an appropriate treatment for urban roadways with 2 travel lanes and average daily traffic of 2,000-5,000 vehicles per day (Table 9 of the *City of Northfield Pedestrian, Bike, and Trail System* report and *Department of Transportation State Aid for*

Local Transportation Division Section 8820.9941). While Hwy 19 includes paved shoulders suitable for bicycle traffic, minimal bicyclist and pedestrian use is assumed. Even though Lincoln Street N's shoulders are currently too narrow for 5'-6' bicycle lanes, bicyclist use is expected.

According to the City of Northfield's *Land Development Code*, sidewalks or trails shall be installed along all arterial and collector streets, and a sidewalk shall be installed on both sides of local streets unless waived by the City Council and when an alternative is proposed that better meets the objects from the *Parks, Open Space, and Trail System Plan*, or when topography disallows grading. Sidewalks are currently provided in the following areas near the intersection of Lincoln Street N and St. Olaf Avenue:

- on both sides of St Olaf Avenue on St. Olaf property, west of Lincoln Street N.
- on the north side of St Olaf Avenue, east of Lincoln Street N.
- on both sides of Lincoln Street N, north of St Olaf Avenue.
- on the east side of Lincoln Street N, south of St Olaf Avenue.

Curb ramps are provided at all quadrants at Intersection 2 but are not ADA compliant.

The Hiawathaland Transit and Go! Northfield bus transit systems both provide local and regional connectivity. The Hiawathaland Transit system's Northfield Express Route is available during the St. Olaf school year and makes stops in the middle of St. Olaf College campus and other major traffic generators in Northfield. This bus route maintains 60-minute headways between buses from 4 pm to 11 pm Monday through Saturday and from 3 pm to 6 pm on Sundays. The Northfield Blue Route is also available. Buses on this route stop in the middle of St. Olaf College campus and circulate the adjacent residential neighborhood to the east. Riders on the Northfield Blue Route can transfer to the Northfield Red Route at City Hall. Headways between buses on the Northfield Blue Route are 45 minutes and the buses run from 6 am to 5:15 pm daily. The Go! Northfield transit system's Northfield Metro Express stops at the St. Olaf College Buntrock Commons and makes stops within Northfield and at Minneapolis colleges and universities, MSP airport, Minneapolis downtown, and Megabus Minneapolis. Buses run approximately every 3 hours from Monday through Friday from 5:30 am to 7:00 pm and make three runs on Saturday and two runs on Sunday. Beyond the local and regional bus system, Hiawathaland Transit provides a "Dial-A-Ride" option to St. Olaf students where they can pay \$1.25 for a token which provides the ability to schedule a one-way ride within city limits.

The Northfield Express Route, the Northfield Blue Route, and the Northfield Metro Express all utilize St. Olaf Avenue for access to and from campus. Many of the students who live off campus live in the adjacent residential neighborhood east of campus where the Northfield Blue Route circulates. It is expected that many students who live in this neighborhood walk, bike, or bus to campus rather than drive.

Traffic Volumes

Due to the lack of traffic count data for this study, assumptions were used in order to develop an existing traffic model for the study area. Average annual daily traffic (AADT) estimates are available through the Minnesota Department of Transportation's Traffic Mapping Application.

Existing AADT counts from were analyzed on Hwy 19 Blvd west of Intersection 1 (Hwy 19 Blvd and St. Olaf Drive), on Lincoln Street N south of Intersection 2 (Lincoln Street N and St. Olaf Avenue), and on St. Olaf Avenue east of Intersection 2. Data is available at the locations from 1997 to 2014. The collection site data from year 2000 and later (the last 20 years) was reviewed to check for variability and growth trends.

Traffic on Hwy 19 Blvd has fluctuated throughout the years, ranging from -13% to 17% annually. Traffic on Lincoln Street N has seen wider variations, ranging from -20% to 29% annually. Overall, traffic volumes have increased at both locations. Traffic varied the least on St. Olaf Avenue, and the overall trend is decreasing.

City of Northfield's population has seen consistent growth, and the population is expected to continue to grow, particularly to the west, as the currently undeveloped land develops for residential or other uses. Considering this, it is assumed that traffic along Hwy 19 and Lincoln Street N will continue to grow at its current rates. A growth rate of 1.6% annual growth is assumed for Hwy 19 Blvd, and a growth rate of 2.1% annual growth is assumed for Lincoln Street N. No growth is assumed for St. Olaf Avenue traffic east of Intersection 2.

Table 1: Historical AADT

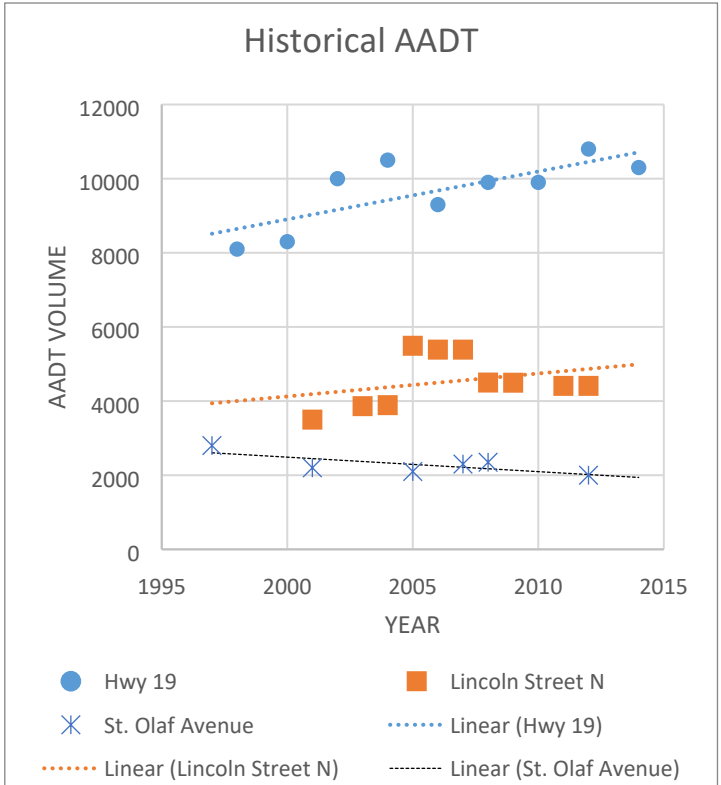


Figure 1: Historical AADT

YEAR	AADT OF HWY 19	PERCENT CHANGE BETWEEN COUNTS	GROWTH HWY 19	AADT OF LINCOLN STREET S	ANNUAL PERCENT CHANGE BETWEEN COUNTS	GROWTH LINCOLN STREET S	AADT OF ST. OLAF AVE	ANNUAL PERCENT CHANGE BETWEEN COUNTS	GROWTH ST. OLAF AVE	
2000	8300	--	--	--	--	--	--	--	--	
2001	--	--	--	3500	--	--	2200	--	--	
2002	10000	17.0%	9.8%	--	--	--	--	--	--	
2003	--	--	--	3863	9%	5%	--	--	--	
2004	10500	4.8%	2.5%	3890	1%	1%	--	--	--	
2005	--	--	--	5492	29%	41%	2100	-5%	-1.2%	
2006	9300	-12.9%	-5.9%	5388	-2%	-2%	--	--	--	
2007	--	--	--	5388	0%	0%	2300	9%	4.7%	
2008	9900	6.1%	3.2%	4500	-20%	-16%	2350	2%	2.2%	
2009	--	--	--	4496	0%	0%	--	--	--	
2010	9900	0.0%	0.0%	--	--	--	--	--	--	
2011	--	--	--	4410	-2%	-1%	--	--	--	
2012	10800	8.3%	4.4%	4410	0%	0%	2000	-18%	-4.0%	
2014	10300	-4.9%	-2.3%	--	--	--	--	--	--	
	Overall Growth Hwy 19 (2000 to 2014)			1.6%		Overall Growth Lincoln St S (2001 to 2012)	2.1%		Overall Growth St. Olaf Ave (2001 to 2012)	-0.9%

Hwy 19 Blvd had an estimated AADT of 10,300 vehicles per day (vpd) in 2014. Projecting 10,300 vpd to year 2022 assuming 1.6% annual growth results in an estimated 2022 AADT of 11,700 vpd. Lincoln Street N south of Intersection 2 had an estimated

AADT of 4,410 vpd in 2012. Projecting 4,410 vpd to year 2022 assuming 2.1% annual growth results in an estimated 2022 AADT of 5,430 vpd. The Minnesota DOT's Traffic Mapping Application also provided a 2014 AADT of 3,970 vpd for the north approach of Intersection 2. Using the established growth rate for Lincoln Street N, projecting 3,970 vpd from 2014 to 2022 results in an estimated 2022 AADT of 4,690 vpd. St. Olaf Avenue east of Intersection 2 had an estimated AADT of 2,000 vpd in 2012, and 2,000 vpd will be assumed for year 2022.

Traffic Analysis Assumptions

A k-factor is an adjustment factor that can be used in a scenario where no hourly traffic data is available. A k-factor is the proportion of AADT occurring in the peak hour. Applying a k-factor to AADT results in a design hour volume. K-factors can range from 7% for high volume urban facilities to 12% or higher for rural or recreational facilities. For this study, it is assumed that a k-factor of 0.10 (10%) can be applied to the existing AADT for the peak hour of traffic on Hwy 19 Blvd, Lincoln Street N, and St. Olaf Avenue east of Intersection 2. This results in design hour volumes of 1,170 vehicles per hour on Hwy 19 Blvd, 598 vehicles per hour on Lincoln Street N, and 200 vehicles per hour on St. Olaf Avenue east of Intersection 2 during the peak hour of traffic.

A d-factor is an adjustment factor that accounts for a disproportionate amount of traffic flowing in the advancing direction versus the opposing direction. The applied d-factors for the intersections assumed 60% of the traffic on Hwy 19 Blvd is westbound and the remaining 40% is eastbound during the evening peak period. In the morning, these percentages would be reversed for westbound and eastbound traffic. On Lincoln Street N, 60% of traffic was assumed to travel northbound and the remaining 40% southbound during the evening peak period. On St. Olaf Avenue east of Intersection 2, 60% of traffic was assumed to travel eastbound and the remaining 40% westbound.

Trip Distribution

Assumed 2022 AADT values, k-factors, and d-factors were used with Florida DOT's Turns5 tool, which assists in estimating turning movements at the intersection of Lincoln Street N and St. Olaf Avenue. Baseline turning movement estimates were created for year 2022 traffic. Due to the lack of count data on St. Olaf Drive and on St. Olaf Avenue west of Intersection 2, the ITE Trip Generation Manual, 10th Edition, was used to estimate current entering and exiting trip volumes at these two major access points to campus. The following table details the ITE Trip Generation Manual's data on for a University/College with 2,800 students, the 2020 full time student enrollment according to St. Olaf College.

Table 2: ITE Trip Generation Manual – University/College

St. Olaf College

ITE Code	550	University/College					2800	Students		
	Average Rate / Formula	# of Generated Trips	% Entering	% Exiting	# of Generated Trips Entering	# of Generated Trips Exiting	# of New Trips Entering	# of New Trips Exiting	Standard Deviation / R ²	# of Studies
Weekday AM Peak Hour of Generator	$\ln(T) = 0.95\ln(X) - 1.63$	369	75%	25%	277	92	277	92	0.96	5
Weekday AM Peak Hour of Adj Street	0.15	420	78%	22%	328	92	328	92	0.05	7
Weekday PM Peak Hour of Generator	$\ln(T) = 0.97\ln(X) - 1.69$	407	32%	68%	130	277	130	277	0.98	5
Weekday PM Peak Hour of Adj Street	$T = 0.16(X) - 187.21$	261	32%	68%	84	177	84	177	0.92	9

Note: Sums may not add as expected due to rounding. Utilized Trip Generation Manual, 10th Edition. Using fitted curve equation for AM Peak Hour of Adjacent Street Traffic resulted in 4 generated trips.

Often with school facilities, the highest hour of traffic generation is the AM peak hour of the generator rather than the AM peak hour of the adjacent street traffic or the PM peak hours of the generator or adjacent street traffic. However, with universities, colleges, and other higher education institutions, the number of generated trips during the AM peak hour of generator, AM peak

hour of adjacent street traffic, and PM peak hour of generator are relatively similar. The biggest difference in traffic behavior between the AM peak hours and the PM peak hour is trip distribution. In the morning, about 75% traffic generated by St. Olaf College would be entering campus rather than leaving and would experience little delay turning into campus. About the same amount of traffic turning into campus in the morning would leave campus in the evening. The vehicles leaving in the evening would experience higher delays than they would have entering in the morning. Using this reasoning, it is anticipated that overall intersection conditions would be similar, if not worse, in the evening than in the morning for Intersections 1 and 2 accessing St. Olaf College.

The data for the Weekday PM peak Hour of Generator was used to estimate peak driveway volumes for St. Olaf Drive and St. Olaf Avenue west of Intersection 2. The entering and exiting trips were then assigned to different user types including visitors, faculty and staff, students living on campus, and students living off campus. St. Olaf College has provided numbers of students living on and off campus, as well as the addresses of students living off-campus. No names were associated with the provided addresses to protect the students' privacy. **Table 3** and **Table 4** summarize the ITE Trip Generation Manual's data for off-campus student apartments. These tables were used to assist with assigning entering and exiting trips based on user type, but it was assumed that most off-campus students, particularly those who lived outside of the City of Northfield area, would arrive in the morning and leave in the evening or may arrive and leave at non-peak hours to attend midday classes. Not all students who arrive and leave their homes during peak hours are traveling to and from campus.

Table 3: ITE Trip Generation Manual – Off-Campus Student Housing (Adjacent to Campus)

Off-Campus Student Housing (Adjacent to Campus)

ITE Code	225	Off-Campus Student Apartment					118	Students		
	Formula	# of Generated Trips	% Entering	% Exiting	# of Generated Trips Entering	# of Generated Trips Exiting	# of New Trips Entering	# of New Trips Exiting	R ²	# of Studies
Weekday PM Peak Hour of Generator	$\ln(T) = 0.72\ln(X) + 0.57$	55	50%	50%	28	28	28	28	0.82	10
Weekday PM Peak Hour of Adj Street	$T = 0.24(X) + 25.88$	54	50%	50%	27	27	27	27	0.84	10

Note: Sums may not add as expected due to rounding. Utilized Trip Generation Manual, 10th Edition.

Table 4: ITE Trip Generation Manual – Off-Campus Student Housing (Over ½ Mile from Campus)

Off-Campus Student Housing (Over 1/2 Mile from Campus)

ITE Code	225	Off-Campus Student Apartment					57	Students		
	Formula	# of Generated Trips	% Entering	% Exiting	# of Generated Trips Entering	# of Generated Trips Exiting	# of New Trips Entering	# of New Trips Exiting	R ²	# of Studies
Weekday PM Peak Hour of Generator	$T = 0.35(X) - 7.67$	12	46%	54%	6	6	6	6	0.82	17
Weekday PM Peak Hour of Adj Street	$T = 0.32(X) - 0.86$	17	49%	51%	8	9	8	9	0.83	17

Note: Sums may not add as expected due to rounding. Utilized Trip Generation Manual, 10th Edition.

Table 5: Existing Trip Generation – Breakdown by User

PM Entering

User	% of Trips	# of Trips
Visitors	55%	72
Campus Students	15%	20
Commuter Students	10%	13
Faculty/Staff	20%	26
Total	100%	130

PM Exiting

User	% of Trips	# of Trips
Visitors	15%	42
Campus Students	15%	42
Commuter Students	10%	28
Faculty/Staff	60%	166
Total	100%	277

Trip Assignment

The parking areas on campus were evaluated for type, size, location, and connectivity to St. Olaf Drive and St. Olaf Avenue. Using this evaluation and considering the likely trip origin points of the various users, it was determined that visitors' routes are similar to the routes of faculty and staff and the routes of on-campus students is similar to those of off-campus students. It was assumed that about 80% of visitors, faculty, and staff use the St. Olaf Drive entrance and 20% use the St. Olaf Avenue entrance. On the other hand, about 75% of students are assumed to use the St. Olaf Avenue entrance and 25% use the St. Olaf Drive entrance. From these entrances, visitors, faculty, and staff mainly travel to and from the west on Hwy 19 Blvd, towards I-35, while others travel to and from the east on Hwy 19 Blvd, towards the center of the City of Northfield, and a small proportion travels north, towards some of Northfield's residential areas. About half of students are assumed to travel to and from the west on Hwy 19 Blvd, towards I-35, and equal proportions of students are assumed to travel to the east on Hwy 19 Blvd and north. Visual representations of these trip distributions are provided in **Appendix E**. These trip distributions were translated to turning movement values at Intersections 1 and 2. These values were then applied to the baseline turning movements established with the aid of the Florida DOT's Turns5 tool. Summary diagrams of the Existing (2022) condition peak hour turning movement volumes are provided in **Appendix F**. Also provided in **Appendix F** is an overview map of the current AADT values on CSAH 7.

Traffic Analysis

At this point in the analysis, design hour volumes and turning movement distributions have been established. Peak hour factor is a variable that further adjusts the design hour volume to account for travel demand variation during the peak hour. The 6th Edition of the Highway Capacity Manual's suggested default peak hour factor value for two-lane highways is 0.88. However, the variability of peak hour factors has been studied, and the empirical formula and method described in Tarko & Perez's 2005 article "Variability of a Peak Hour Factor at Intersections" can be used to better estimate an intersection's peak hour factor based on community

population, traffic volume, and time of day. Using the methods described in Tarko & Perez's article, an evening peak hour factor of 0.90 is assumed for all existing traffic movements at Intersection 1 and an evening peak hour factor of 0.88 is assumed for all existing traffic movements at Intersection 2.

To analyze and model the traffic conditions within the study area, Synchro Version 10.3, Highway Capacity Manual, 6th Edition Delay Method was utilized. Synchro analysis worksheets were prepared for the Existing (2022) conditions and are provided in **Appendix G. Table 6** and **Table 7** show the existing level of service (LOS) and delay for Intersections 1 and 2 for the analyzed peak hour period. See the **Level of Service and Delay Comparison** section for discussion on level of service and delay.

Table 6: Existing (2022) LOS – Intersection 1

INTERSECTION 1	PM PEAK												
	2022 EXISTING												
	Overall	Eastbound			Westbound			Northbound			Southbound		
Hwy 19 Blvd & St. Olaf Drive		L	T	R	L	T	R	L	T	R	L	T	R
Volume (veh)		91	611			454	14				30		192
Queue (ft)		94				0	0				34		64
Mvmt Delay (sec)		8.8	0.5			0.0	0.0				26.4		15.1
Mvmt LOS		A	A			A	A				D		C
Delay (sec)	3.5	1.6			0.0						16.6		
LOS	A	A			A						C		

Source: Data was analyzed using Synchro (HCM 6th Edition) and Sim Traffic (queue).

Table 7: Existing (2022) LOS – Intersection 2

INTERSECTION 2	PM PEAK												
	2022 EXISTING												
	Overall	Eastbound			Westbound			Northbound			Southbound		
Lincoln Street N & St. Olaf Avenue		L	T	R	L	T	R	L	T	R	L	T	R
Volume (veh)		27	0	30	30	0	50	14	174	138	104	71	13
Queue (ft)		51			47			98			74		
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	10.1	8.7			8.8			10.9			9.8		
LOS	B	A			A			B			A		

Source: Data was analyzed using Synchro (HCM 6th Edition) and Sim Traffic (queue).

PROPOSED CONDITIONS

Trip Generation

Currently, many students are living in areas within existing residence halls on St. Olaf College campus that were not initially meant for student beds. Due to limited housing space on campus, some students have lived off-campus instead. The proposed student housing development would allow students who would have lived in overflow housing areas within the existing residence halls and off-campus students to live on campus in rooms meant for student beds. Existing student parking areas would remain as student parking, and a new 182-stall student parking lot would be constructed to supplement the existing student parking.

The proposed development would have little impact on visitor, faculty, and staff parking areas, trip distribution, and preferred access points. This proposed development, however, would impact student trip generation, distribution, and assignment. 6 off-campus student address were of locations outside of the Northfield area. These may be non-traditional full-time students or traditional students who have been allowed to commute from their family's homes. It is assumed that these students would continue to live off-campus, despite the proposed student housing development. All other students who would have driven to and from campus from their off-campus housing would instead remain on campus. These formerly off-campus students may still leave and return to campus but they would be doing so as an on-campus user.

Because of this change in trip generation, distribution, and assignment, a revised "Trip Generation – Breakdown by User" was prepared for the Proposed (2022) condition. This table is provided below as **Table 8**.

Table 8: Proposed Trip Generation – Breakdown by User

PM Entering

User	% of Trips	# of Trips
Visitors	55%	72
Campus Students	20%	26
Commuter Students	1%	1
Faculty/Staff	20%	26
Total	96%	130

PM Exiting

User	% of Trips	# of Trips
Visitors	15%	42
Campus Students	20%	55
Commuter Students	1%	3
Faculty/Staff	60%	166
Total	96%	277

Trip Distribution and Trip Assignment

Because the proposed student housing development includes the construction of a new 182-stall parking lot, an increased proportion of student traffic is expected to use the St. Olaf Avenue campus access. Rather than 75% of traffic, it is assumed that 90% of student traffic will use the St. Olaf Avenue access point in the Opening (2022) condition. Students, if they leave and return

to campus at all, are more likely to be attending events, visiting restaurants or shopping within the City of Northfield or the Minnesota region, not traveling to and from residences within Northfield. Because of this, is assumed most student traffic will be traveling on Hwy 19 Blvd to either travel towards the center of the City of Northfield or towards I-35. Visual representations of proposed trip distributions are provided in **Appendix H**.

Modal Split

No cyclist information was available for this study. While cyclists are accommodated on Hwy 19 Blvd, few cyclists are expected. Cyclists are allowed on Lincoln Street N but are not provided on-street bicycle accommodations. An increase of pedestrian presence on Hwy 19 Blvd is not expected. Currently students without a parking permit can park their vehicles within the eastern residential neighborhood and walk onto campus. Because most students are expected to live on campus after the student housing development project is complete, fewer pedestrians and bicyclists are expected along Lincoln Street N than in the Existing (2022) condition. Rather, the existing transit system, particularly the local buses, may experience increased use as more students take advantage of the bus rather than vehicles to travel to points of interest within the City of Northfield.

TRAFFIC ANALYSIS

Capacity and Level of Service at Studied Intersections

Similar to the calculations for the Existing (2022) condition, the proposed trip distributions were again translated to turning movement values at Intersections 1 and 2. These values were then applied to the baseline turning movements established with the aid of the Florida DOT's Turns5 tool. Summary diagrams of the Opening (2022) condition peak hour turning movement volumes are provided with the Existing (2022) peak hour turning movement volumes in **Appendix F**. Synchro analysis worksheets were prepared for the Opening (2022) condition and are provided in **Appendix I**. **Table 9** and **Table 10** show the existing level of service (LOS) and delay for Intersections 1 and 2 for the analyzed peak hour period.

Table 9: Opening (2022) LOS – Intersection 1

INTERSECTION 1	PM PEAK												
	2022 OPENING												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Hwy 19 Blvd & St. Olaf Drive													
Volume (veh)		75	611			454	12				24		158
Queue (ft)		92				18	0				38		36
Mvmt Delay (sec)		8.7	0.4			0.0	0.0				23.7		14.2
Mvmt LOS		A	A			A	A				C		B
Delay (sec)	2.8	1.3			0.0						15.5		
LOS	A	A			A						C		

Source: Data was analyzed using Synchro (HCM 6th Edition) and Sim Traffic (queue).

Table 10: Opening (2022) LOS – Intersection 2

INTERSECTION 2	PM PEAK												
	2022 OPENING												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Lincoln Street N & St. Olaf Avenue													
Volume (veh)		13	0	71	30	0	50	34	174	138	104	71	6
Queue (ft)		50			50			96			72		
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	10.5	8.8			9.0			11.6			9.9		
LOS	B	A			A			B			A		

Source: Data was analyzed using Synchro (HCM 6th Edition) and Sim Traffic (queue).

Level of Service and Delay Comparison

Table 11 and **Table 12** provide a side-by-side comparison in the change in delay and level of service for the studied intersections' approaches. The traffic models developed for this study, using existing AADT data, assumed growth rates, turning movement distribution tools, and the proposed trip generation, distribution, and assignment, show that Intersection 1 operates at an overall level of service (LOS) A and Intersection 2 operates at an overall level of service B in the Existing (2022) and Opening (2022) conditions. In the Existing (2022) and Opening (2022) conditions, all approaches for studied intersections operate at LOS A-C during the analyzed peak hour. In the Existing (2022) condition, off-campus students commuting to campus would use Intersection 1 and 2 to park in commuter lots. In the Opening (2022) condition, off-campus students would instead live on campus and would not need to commute to campus, causing a decrease in use at Intersection 1. Additionally, students who may frequently leave campus may choose to park in the new parking lot and use Intersection 2 rather park in the student lots in the northwestern part of campus and use Intersection 1. Therefore, completing the proposed student housing project school facility is expected to redistribute traffic away from Intersection 1 and to Intersection 2, causing delay to decrease at Intersection 1 and delay to increase at Intersection 2. Changes in delay are minimal. Level of service at the approaches for both studied intersections are not expected to change as a result of the proposed project.

Table 11: LOS Comparison - Intersection 1

	INTERSECTION 1	PM PEAK				
	Hwy 19 Blvd & St. Olaf Drive	Overall	Eastbound	Westbound	Northbound	Southbound
Existing (2022)	Delay (sec)	3.5	1.6	0.0		16.6
	LOS	A	A	A		C
Opening (2022)	Delay (sec)	2.8	1.3	0.0		15.5
	LOS	A	A	A		C

	INTERSECTION 1	PM PEAK CHANGE IN DELAY			
	Hwy 19 Blvd & St. Olaf Drive	Eastbound	Westbound	Northbound	Southbound
Existing (2022) / Opening (2022)	Delay (%)	-18.8%	0.0%		-6.6%

Table 12: LOS Comparison - Intersection 2

	INTERSECTION 2	PM PEAK				
	Lincoln Street N & St. Olaf Avenue	Overall	Eastbound	Westbound	Northbound	Southbound
Existing (2022)	Delay (sec)	10.1	8.7	8.8	10.9	9.8
	LOS	B	A	A	B	A
Opening (2022)	Delay (sec)	10.5	8.8	9.0	11.6	9.9
	LOS	B	A	A	B	A

	INTERSECTION 2	PM PEAK CHANGE IN DELAY			
	Lincoln Street N & St. Olaf Avenue	Eastbound	Westbound	Northbound	Southbound
Existing (2022) / Opening (2022)	Delay (%)	1.1%	2.3%	6.4%	1.0%

Crash Analysis

Crash data within the vicinity of the studied intersections for the past 5 years was obtained using the Minnesota Crash Mapping Analysis Tool 2 (MnCMAT2). A map of the crash data is provided in **Appendix J**. Between 2015 and June of 2020 there have been no type K or A crashes, 1 type B crash, 2 type C crashes, and 2 property damage only crashes (type N).

These crash types are defined in the Guide to MN Crash Data Files and the MN Law Enforcement Accident Report Instruction Manual as described in the following table.

Crash Type	Severity Type	Description
Type K	Killed	A fatality resulted.
Type A	Incapacitating injury	Any injury, other than a fatal injury, which prevents the injured person from walking, driving, or normally continuing the activities the person was capable of performing before the injury occurred.
Type B	Non-incapacitating injury	Any injury, other than a fatal injury or an incapacitating injury, which is evident to the observers at the scene of the accident in which the injury occurred.
Type C	Possible injury	Any injury reported or claimed which is not a fatal injury, incapacitating injury or non-incapacitating evident injury.
Type N	No apparent injury	Property damage only.

All crashes identified using MnCMAT2 occurred at Intersection 1 (the intersection of Hwy 19 Blvd and St. Olaf Drive). No crashes have been recorded at Intersection 2 between 2015 and June 2020. Most of the crashes occurred between 4:00 PM and 6:00 PM, and all occurred on different days of the week in March, April, or May. Three of the crashes were rear end collisions and the remaining two crashes were angle type collisions. For all three rear end collisions, a vehicle was waiting to turn left onto St. Olaf Drive from Hwy 19 Blvd and were struck from behind by vehicles also traveling eastbound but did not move into the bypass lane in time to avoid a collision. For both angle collisions, southbound vehicles on St. Olaf Drive were unable to stop at the stop sign due to slush and snow conditions and hit vehicles traveling westbound on Hwy 19 Blvd.

From MnDOT's *Traffic Safety Fundamentals Handbook*, the average crash rate at urban two-way stop-controlled, unsignalized intersections on the trunk highway system is 0.18 crashes per million entering vehicles (MEV), and the average crash rate at rural two-way stop-controlled, unsignalized intersections on the trunk highway system is 0.25 crashes per MEV. At Intersection 1, the calculated intersection crash rate is 0.18 crashes per MEV. The recorded crash data does not indicate a need for geometric or traffic control changes any of the studied intersections due to safety.

Improvements to Accommodate Site Traffic

No improvements are required in order to accommodate site traffic.

RECOMMENDATIONS + CONCLUSIONS

The proposed St. Olaf student housing development project located along St. Olaf Avenue west of Lincoln Street N and north of Hwy 19 Blvd will redistribute existing traffic once constructed. Rather than using the intersection of Hwy 19 Blvd and St. Olaf Drive to access campus, more students are expected to use the intersection of Lincoln Street N and St. Olaf Avenue. This traffic will utilize St. Olaf Avenue to access a new student parking lot. The intersection of Hwy 19 Blvd and St. Olaf Drive and the intersection of Lincoln Street N and St. Olaf Avenue were studied. The redistribution of traffic expected as a result of the proposed traffic is expected to decrease entering traffic at the intersection of Hwy 19 Blvd and St. Olaf Drive. In return, the redistribution of traffic is expected to increase entering traffic at the intersection of Lincoln Street N and St. Olaf Avenue. This traffic redistribution is expected to have minimal impacts to the adjacent public roadway network.

Regardless of the proposed development, the City of Northfield should maintain pedestrian and bicycle facilities in accordance with the *City of Northfield Pedestrian, Bike, and Trail System* report and the *City of Northfield Americans with Disabilities Act Pedestrian Facilities Transition Plan*. Actions would include:

- Ensuring trails or ADA compliant sidewalks are constructed along both sides of Lincoln Street N.
- Ensuring ADA compliant sidewalks are constructed along both sides of St. Olaf Avenue.
- Reconstructing existing curb ramps at the intersection of Lincoln Street N and St. Olaf Avenue so they are ADA compliant.
- Construct/install 5'-6' on-street bicycle lanes on Lincoln Street N.

This area should be re-evaluated if growth projections change or when a major development occurs in the future.

Appendix A: Preliminary Site Plan

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Reese A. Sudtlegte

DATE _____
LIC. NO. 54243



NOTE:
THE CLARITY OF THESE PLANS
DEPEND UPON COLOR COPIES.
IF THIS TEXT DOES NOT APPEAR
IN COLOR, THIS IS NOT AN
ORIGINAL PLAN SET AND MAY
RESULT IN MISINTERPRETATION.

PROJECT: **OLE AVENUE PROJECT**

ADDRESS:

[illegible]

WSA PROJECT #: 19-270

DATE: June 04, 2020

50% DESIGN DEVELOPMENT

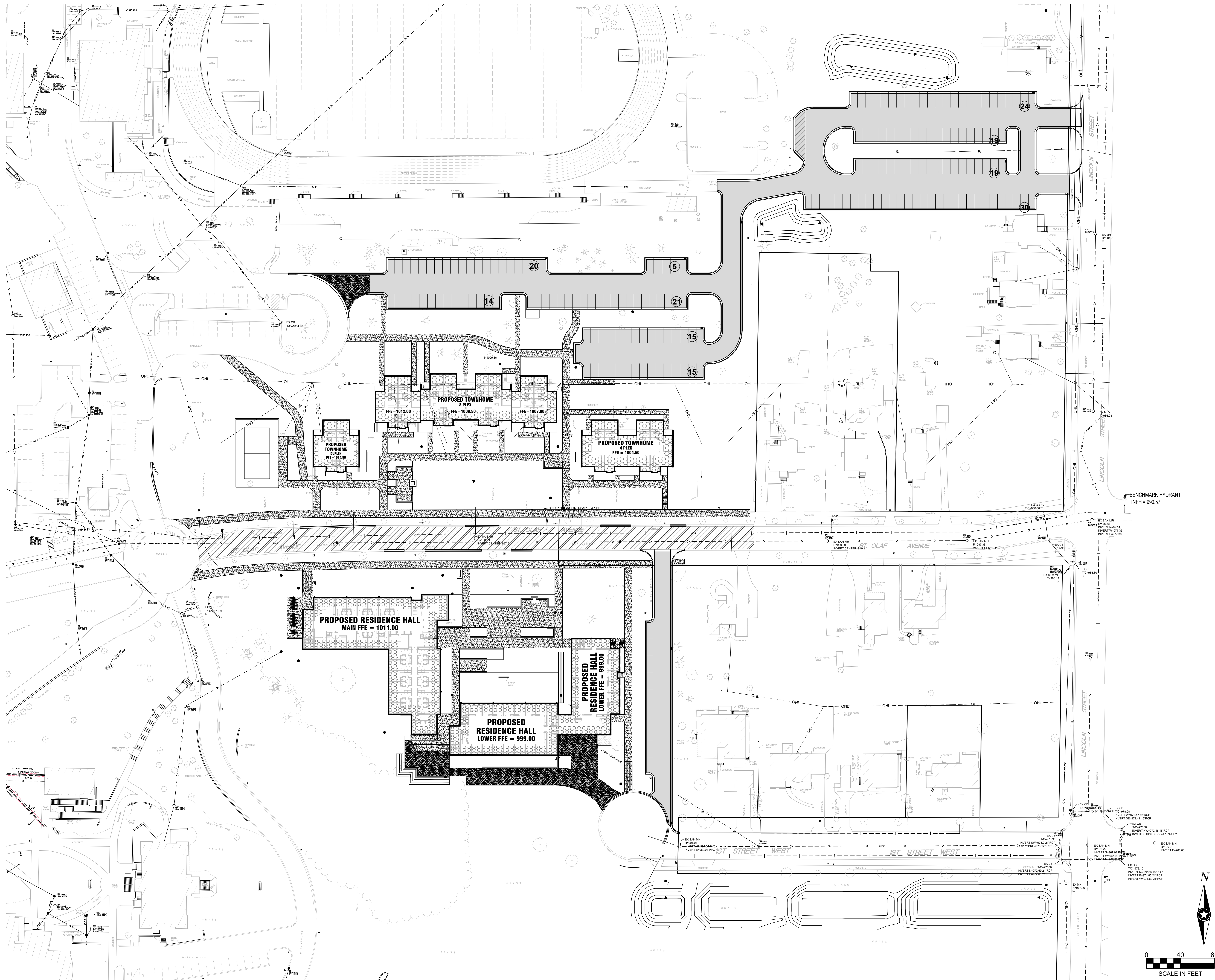
**PROPOSED SITE PLAN
(OVERALL)**

C3-10

○ COPYRIGHT WORKSHOP ARCHITECTS, INC.

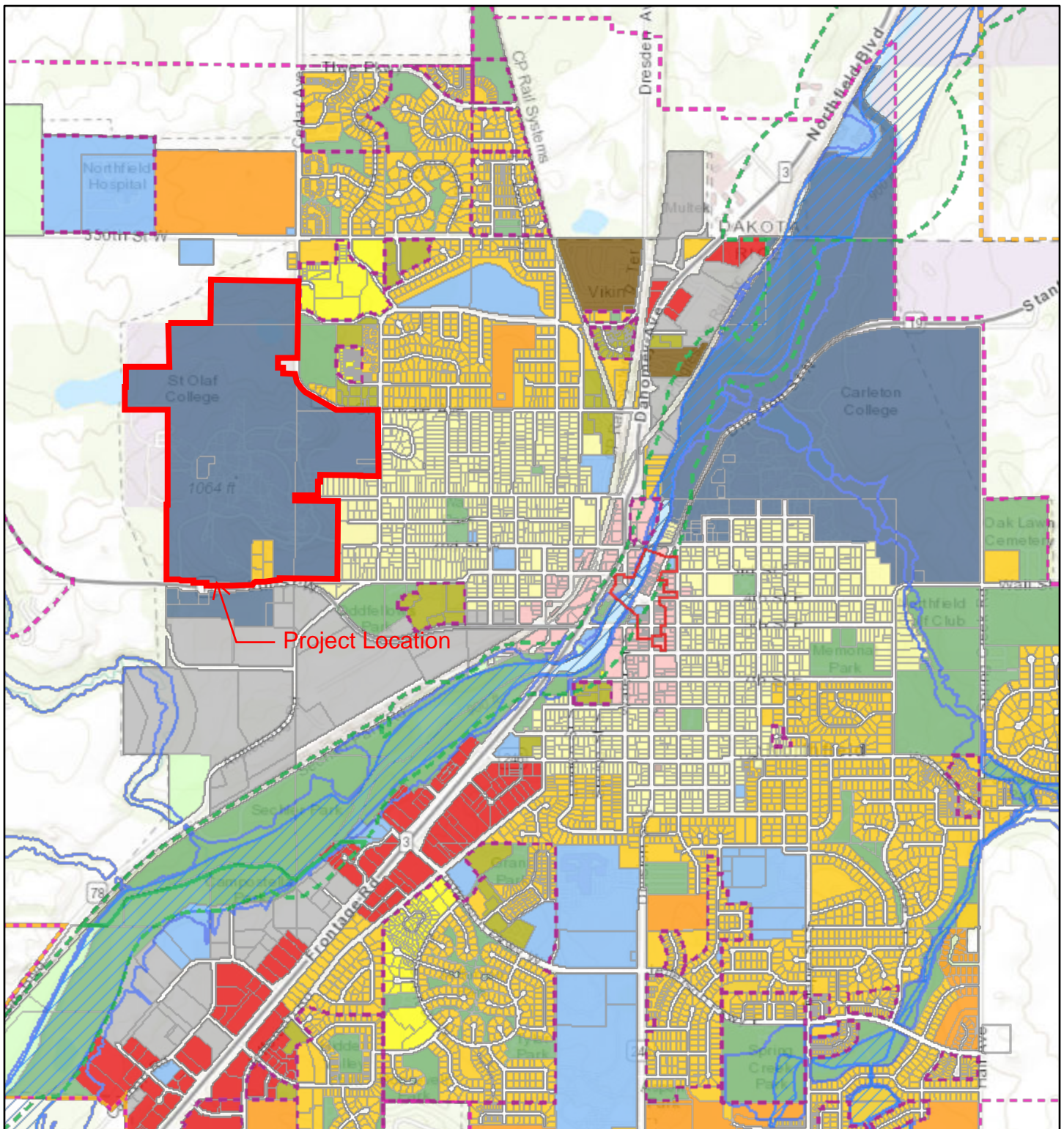
FILE NAME: 23859 C3-SIT

FOR REFERENCE ONLY



Appendix B: Project Location Map

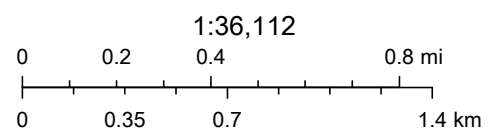
City of Northfield



6/17/2020, 3:13:09 PM

Rice County Parcels

- | | |
|--|--|
| R1-B: Low Density Residential | N2-B: Neighborhood General 2 |
| R2-B: Medium Density Residential | NC-F |
| R3-B: High Density Residential | C1-B: Downtown |
| R4-B: Manufactured Home Park | C2-B: Highway Commercial |
| N1-B: Neighborhood General 1 | I1-B: Industrial |
| | A-S: Agricultural |



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

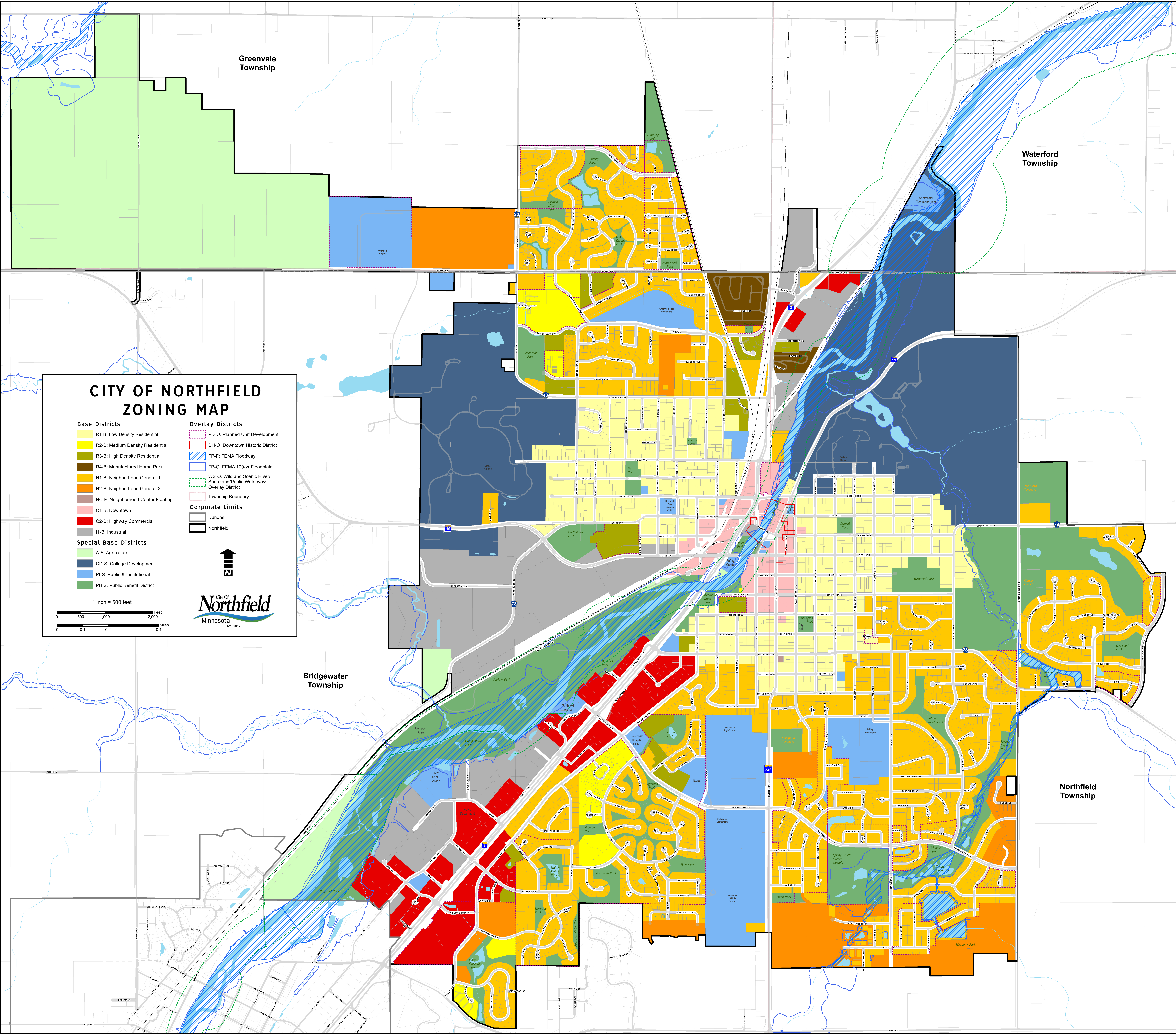
Appendix C: Intersection Location Map



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ST OLAF STUDENT HOUSING
NORTHFIELD, MN - 6/22/20
ISG PROJECT NO. 20-23959

Appendix D: City of Northfield Zoning Map



CITY OF NORTHFIELD ZONING MAP

Base Districts

- R1-B: Low Density Residential
- R2-B: Medium Density Residential
- R3-B: High Density Residential
- R4-B: Manufactured Home Park
- N1-B: Neighborhood General 1
- N2-B: Neighborhood General 2
- NC-F: Neighborhood Center Floating
- C1-B: Downtown
- C2-B: Highway Commercial
- I1-B: Industrial

Special Base Districts

- A-S: Agricultural
- CD-S: College Development
- PI-S: Public & Institutional
- PB-S: Public Benefit District

Overlay Districts

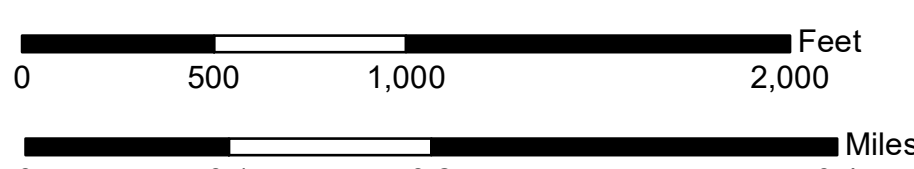
- PD-O: Planned Unit Development
- DH-O: Downtown Historic District
- FP-F: FEMA Floodway
- FP-Q: FEMA 100-yr Floodplain
- WS-O: Wild and Scenic River/Shoreland/Public Waterways Overlay District
- Township Boundary

Corporate Limits

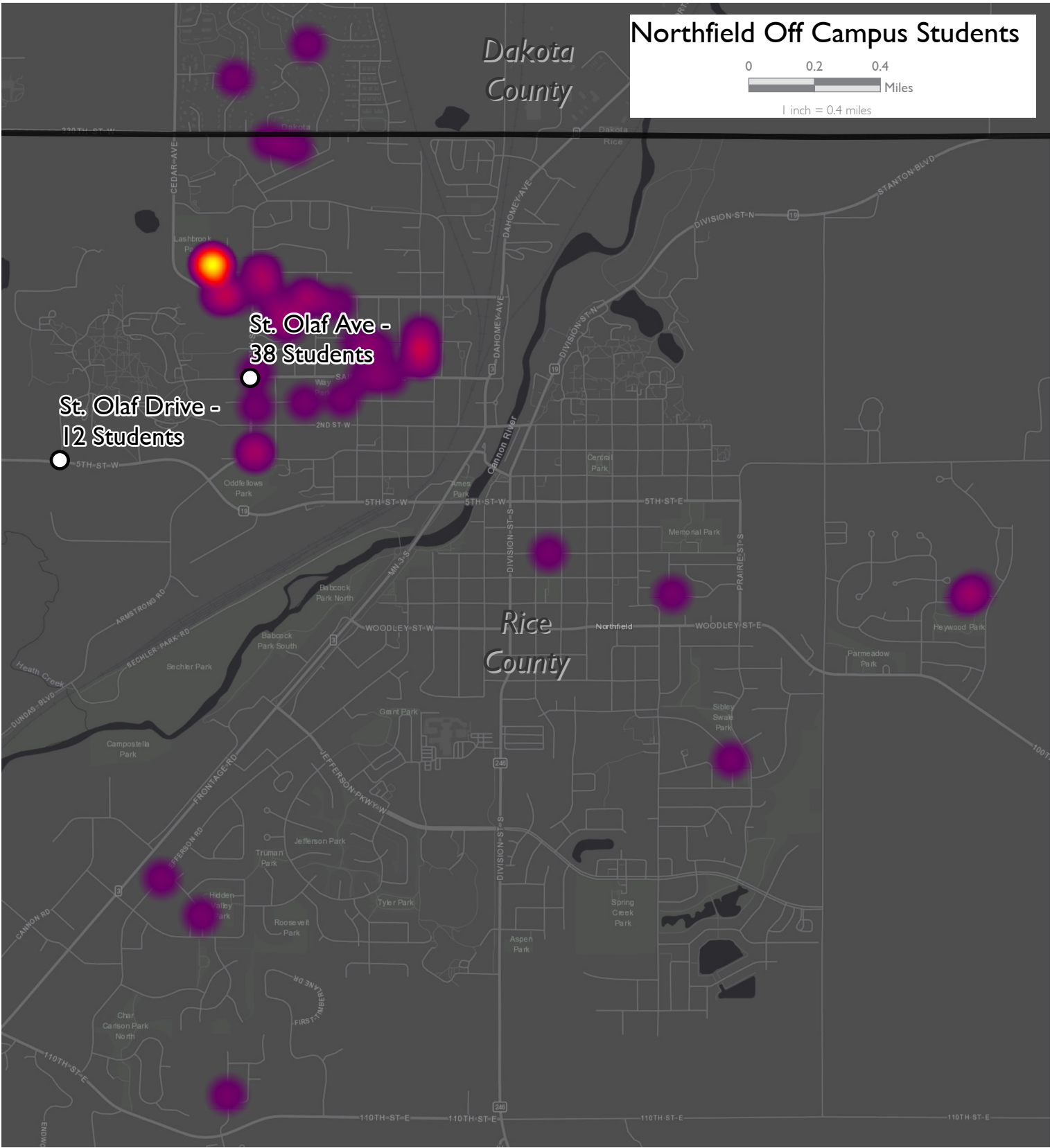
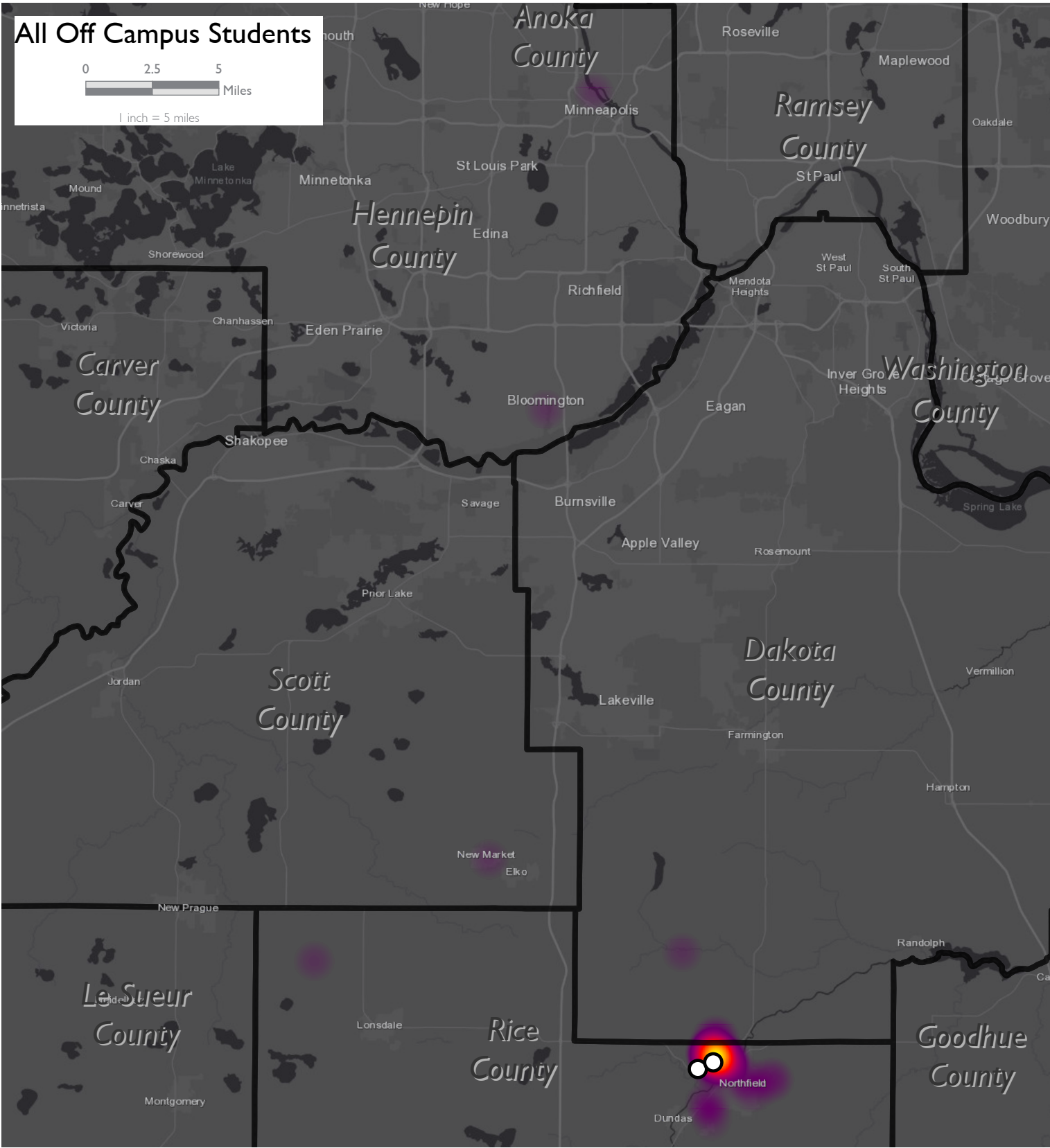
- Dundas
- Northfield



1 inch = 500 feet



Appendix E: Existing Trip Distribution



Tuesday, June 16, 2020

Project Number 20-23959

Legend

- Entrance Locations
- ▬ Counties
- Student Density
 - Sparse
 - Dense



St. Olaf Off-Campus Students Heat Map

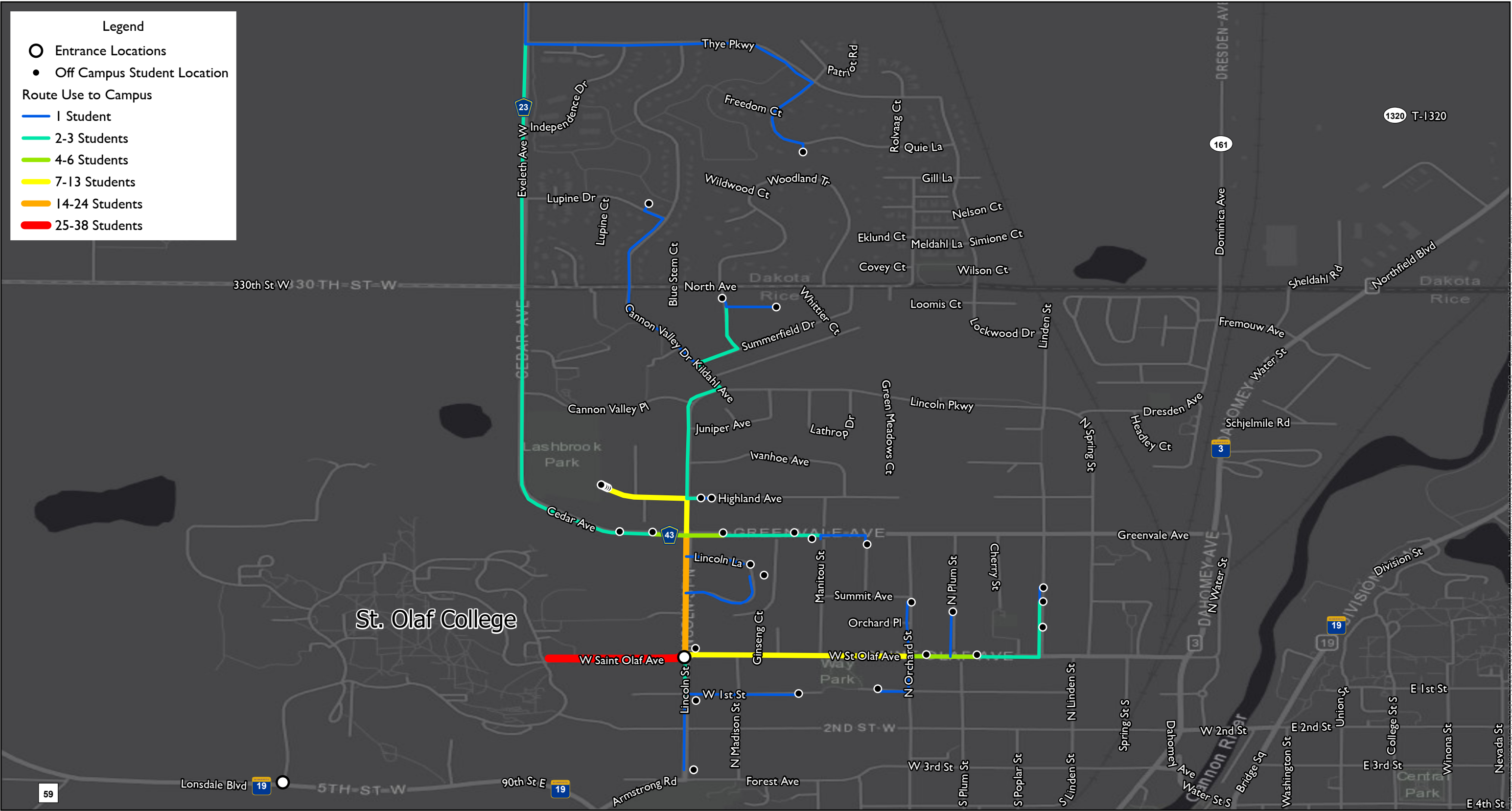
St. Olaf Student Housing

Northfield, Rice County, Minnesota

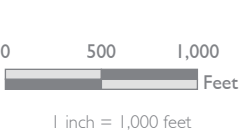
Source(s):
Basemap (ESRI)



S:\Projects\23000 PROJ\23900-23999\23959 St. Olaf Student Housing-Northfield MN\23959 GIS\23959 MapDocs\23959 - Student Housing.aprx



Wednesday, June 17, 2020 Project Number 20-23959



St. Olaf Off-Campus Students Route Map
St. Olaf Student Housing
Northfield, Rice County, Minnesota

Source(s):
Basemap (ESRI)

ISG











0 200 400
SCALE: 1" = 200 FEET



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ST. OLAF STUDENT HOUSING
NORTHFIELD, MN - 06/22/2020
ISG PROJECT NO. 20-23959

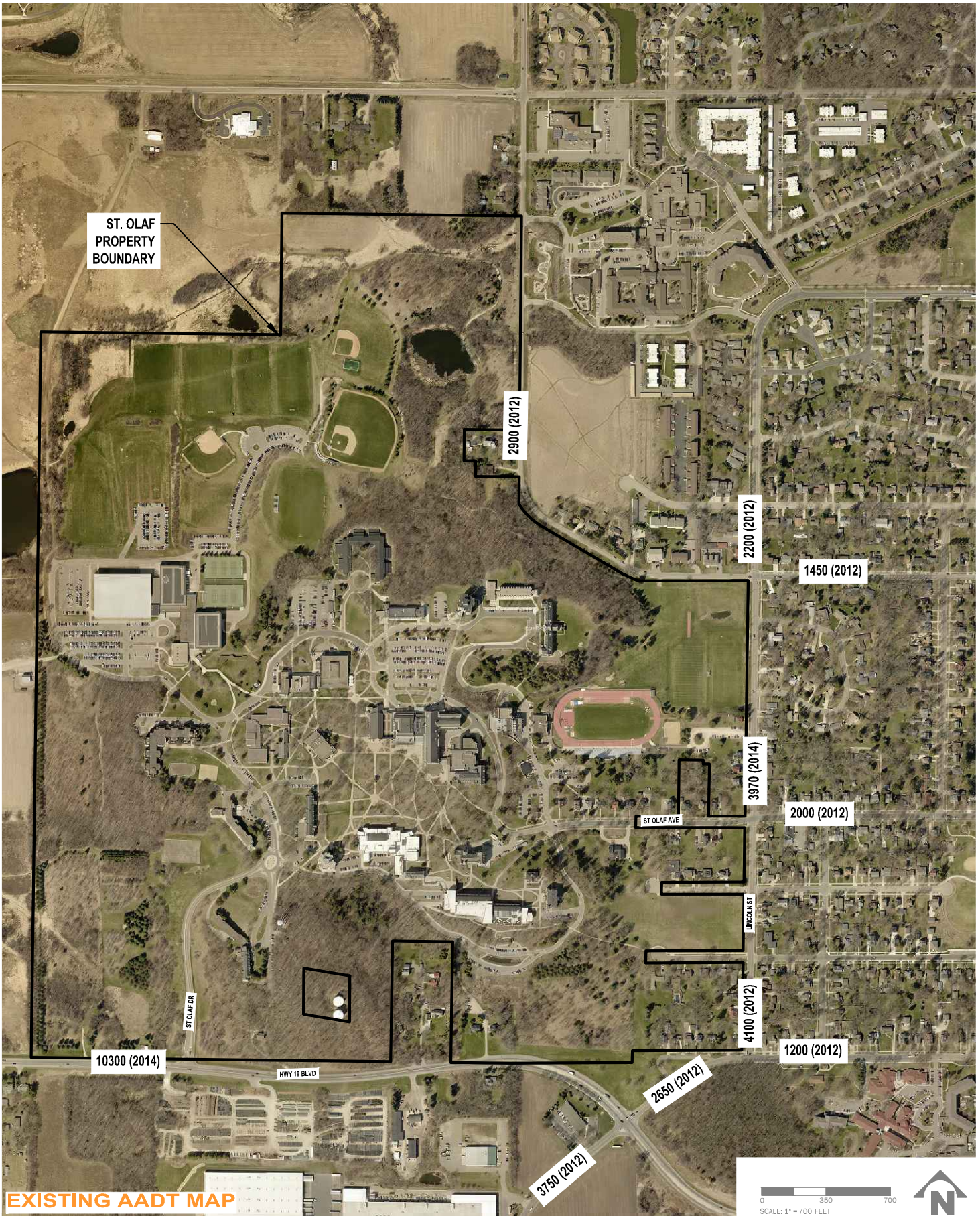
ISGInc.com

CAD FILE NAME 23959 TRIP DISTRIBUTIONS OVERALL.F



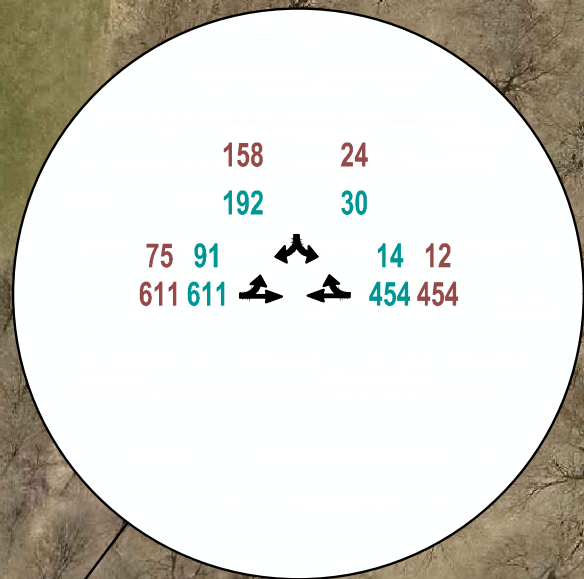
TRIP DISTRIBUTION (EXISTING) - PM EXITING FACULTY / STAFF / VISITOR

Appendix F: Traffic Volumes



EXISTING

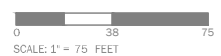
OPENING 2022



ST OLAF DR

HWY 19 BLVD

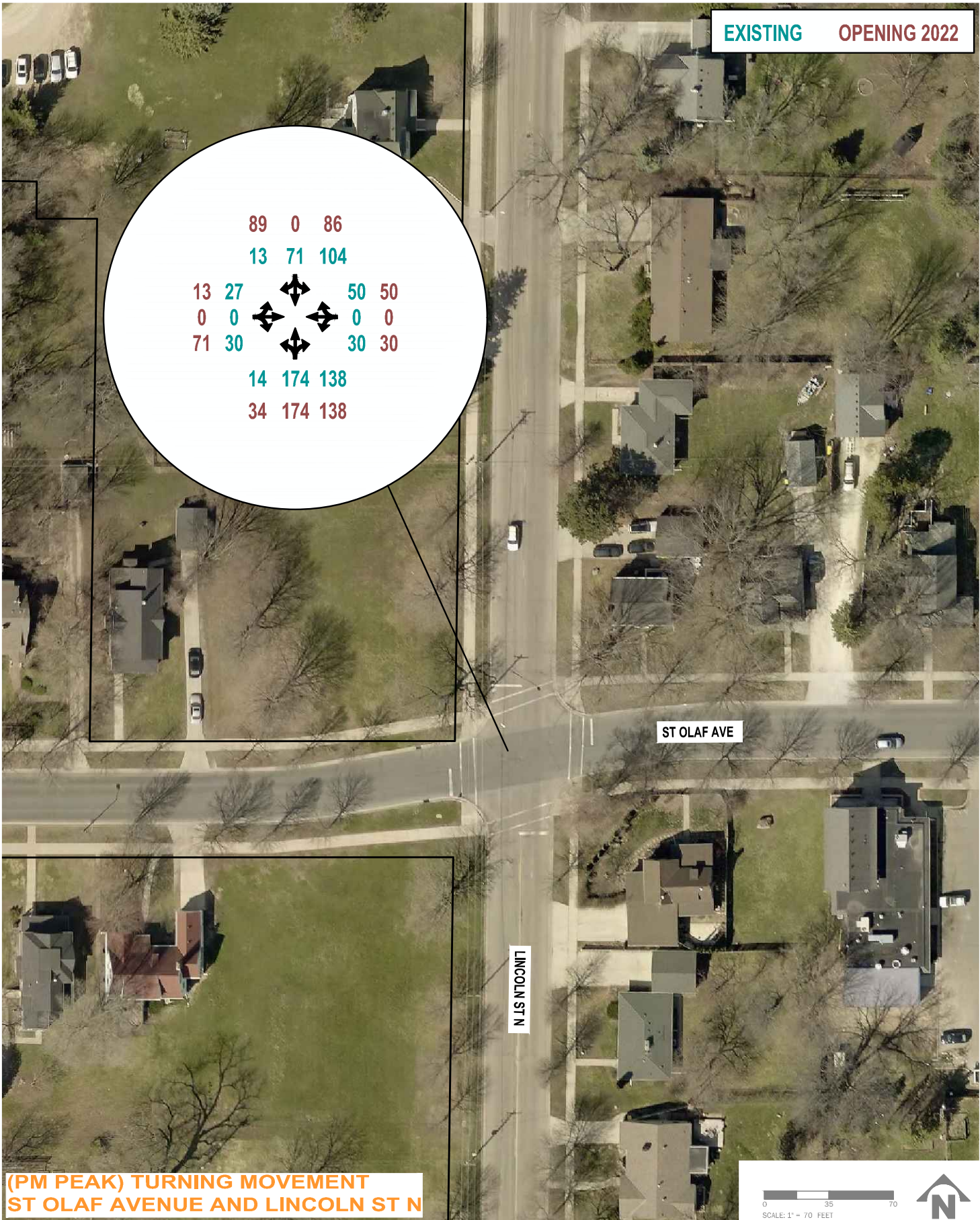
(PM PEAK) TURNING MOVEMENT
ST OLAF DRIVE AND HIGHWAY 19 BOULEVARD



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NORTHFIELD, MN - 06/22/2020
20-23959



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NORTHFIELD, MN - 06/22/2020
20-23959

Appendix G: Existing (2022) Synchro Analysis Worksheets

Intersection

Int Delay, s/veh 3.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔	↑	↗	↖	↗
Traffic Vol, veh/h	91	611	454	14	30	192
Future Vol, veh/h	91	611	454	14	30	192
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	180	0	120
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	8	8	2	2	2
Mvmt Flow	101	679	504	16	33	213

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	520	0	0 1046 504
Stage 1	-	-	- 504 -
Stage 2	-	-	- 542 -
Critical Hdwy	4.13	-	- 6.63 6.23
Critical Hdwy Stg 1	-	-	- 5.43 -
Critical Hdwy Stg 2	-	-	- 5.83 -
Follow-up Hdwy	2.219	-	- 3.519 3.319
Pot Cap-1 Maneuver	1044	-	- 238 567
Stage 1	-	-	- 606 -
Stage 2	-	-	- 548 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1044	-	- 201 567
Mov Cap-2 Maneuver	-	-	- 201 -
Stage 1	-	-	- 512 -
Stage 2	-	-	- 548 -

Approach	EB	WB	SB
HCM Control Delay, s	1.6	0	16.6
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1044	-	-	-	201	567
HCM Lane V/C Ratio	0.097	-	-	-	0.166	0.376
HCM Control Delay (s)	8.8	0.5	-	-	26.4	15.1
HCM Lane LOS	A	A	-	-	D	C
HCM 95th %tile Q(veh)	0.3	-	-	-	0.6	1.7

HCM 6th AWSC
2: Lincoln Street N & St. Olaf Ave

06/19/2020

Intersection	
Intersection Delay, s/veh	10.1
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	27	0	30	30	0	50	14	174	138	104	71	13
Future Vol, veh/h	27	0	30	30	0	50	14	174	138	104	71	13
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	31	0	34	34	0	57	16	198	157	118	81	15
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	8.7	8.8	10.9	9.8
HCM LOS	A	A	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	4%	47%	38%	55%
Vol Thru, %	53%	0%	0%	38%
Vol Right, %	42%	53%	62%	7%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	326	57	80	188
LT Vol	14	27	30	104
Through Vol	174	0	0	71
RT Vol	138	30	50	13
Lane Flow Rate	370	65	91	214
Geometry Grp	1	1	1	1
Degree of Util (X)	0.446	0.093	0.127	0.284
Departure Headway (Hd)	4.332	5.142	5.022	4.793
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	830	691	708	746
Service Time	2.377	3.215	3.092	2.846
HCM Lane V/C Ratio	0.446	0.094	0.129	0.287
HCM Control Delay	10.9	8.7	8.8	9.8
HCM Lane LOS	B	A	A	A
HCM 95th-tile Q	2.3	0.3	0.4	1.2

Queuing and Blocking Report

Existing PM

06/22/2020

Intersection: 1: Hwy 19 Blvd & St. Olaf Dr

Movement	EB	EB	SB	SB
Directions Served	LT	T	L	R
Maximum Queue (ft)	105	6	36	90
Average Queue (ft)	47	1	16	51
95th Queue (ft)	98	8	40	96
Link Distance (ft)	654	654	665	
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				120
Storage Blk Time (%)				0
Queuing Penalty (veh)				0

Intersection: 2: Lincoln Street N & St. Olaf Ave

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	53	49	84	58
Average Queue (ft)	30	29	60	41
95th Queue (ft)	57	52	94	62
Link Distance (ft)	960	986	312	675
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 0

Appendix H: Proposed Trip Distribution







TRIP DISTRIBUTION (OPENING 2022) - PM ENTERING STUDENTS



TRIP DISTRIBUTION (OPENING 2022) - PM EXITING STUDENTS



TRIP DISTRIBUTION (OPENING 2022) - PM ENTERING OVERALL



TRIP DISTRIBUTION (OPENING 2022) - PM EXITING OVERALL

Appendix I: Opening (2022) Synchro Analysis Worksheets

Intersection

Int Delay, s/veh 2.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔	↑	↗	↖	↗
Traffic Vol, veh/h	75	611	454	12	24	158
Future Vol, veh/h	75	611	454	12	24	158
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	180	0	120
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	8	8	2	2	2
Mvmt Flow	83	679	504	13	27	176

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	517	0	0 1010 504
Stage 1	-	-	- 504 -
Stage 2	-	-	- 506 -
Critical Hdwy	4.13	-	- 6.63 6.23
Critical Hdwy Stg 1	-	-	- 5.43 -
Critical Hdwy Stg 2	-	-	- 5.83 -
Follow-up Hdwy	2.219	-	- 3.519 3.319
Pot Cap-1 Maneuver	1047	-	- 251 567
Stage 1	-	-	- 606 -
Stage 2	-	-	- 571 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1047	-	- 219 567
Mov Cap-2 Maneuver	-	-	- 219 -
Stage 1	-	-	- 529 -
Stage 2	-	-	- 571 -

Approach	EB	WB	SB
HCM Control Delay, s	1.3	0	15.5
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1047	-	-	-	219	567
HCM Lane V/C Ratio	0.08	-	-	-	0.122	0.31
HCM Control Delay (s)	8.7	0.4	-	-	23.7	14.2
HCM Lane LOS	A	A	-	-	C	B
HCM 95th %tile Q(veh)	0.3	-	-	-	0.4	1.3

Intersection	
Intersection Delay, s/veh	10.5
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	13	0	71	30	0	50	34	174	138	104	71	6
Future Vol, veh/h	13	0	71	30	0	50	34	174	138	104	71	6
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	15	0	81	34	0	57	39	198	157	118	81	7
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	8.8	9	11.6	9.9
HCM LOS	A	A	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	10%	15%	38%	57%
Vol Thru, %	50%	0%	0%	39%
Vol Right, %	40%	85%	62%	3%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	346	84	80	181
LT Vol	34	13	30	104
Through Vol	174	0	0	71
RT Vol	138	71	50	6
Lane Flow Rate	393	95	91	206
Geometry Grp	1	1	1	1
Degree of Util (X)	0.483	0.131	0.129	0.281
Departure Headway (Hd)	4.425	4.941	5.121	4.925
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	810	718	693	724
Service Time	2.481	3.022	3.204	2.993
HCM Lane V/C Ratio	0.485	0.132	0.131	0.285
HCM Control Delay	11.6	8.8	9	9.9
HCM Lane LOS	B	A	A	A
HCM 95th-tile Q	2.7	0.4	0.4	1.2

Queuing and Blocking Report

Opening PM

06/22/2020

Intersection: 1: Hwy 19 Blvd & St. Olaf Dr

Movement	EB	WB	SB	SB
Directions Served	LT	T	L	R
Maximum Queue (ft)	91	8	31	62
Average Queue (ft)	31	2	15	36
95th Queue (ft)	92	18	38	65
Link Distance (ft)	654	310	665	
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)			120	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Lincoln Street N & St. Olaf Ave

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	50	48	92	70
Average Queue (ft)	34	32	62	43
95th Queue (ft)	50	50	96	72
Link Distance (ft)	960	986	312	675
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 0

Appendix J: Crash Data Map

